Start-Up, Operation, and Maintenance Instructions

SAFETY CONSIDERATIONS

Screw liquid chillers are designed to provide safe and reliable service when operated within design specifications. When operating this equipment, use good judgment and safety precautions to avoid damage to equipment and property or injury to personnel.

Be sure you understand and follow the procedures and safety precautions contained in the machine instructions, as well as those listed in this guide.

⚠ DANGER

DO NOT VENT refrigerant relief valves within a building. Outlet from rupture disc or relief valve must be vented outdoors in accordance with the latest edition of ANSI/ASHRAE 15 (American National Standards Institute, American Society of Heating, Refrigeration, and Air Conditioning Engineers), latest edition. The accumulation of refrigerant in an enclosed space can displace oxygen and cause asphyxiation.

PROVIDE adequate ventilation in accordance with ANSI/ASHRAE 15, especially for enclosed and low overhead spaces. Inhalation of high concentrations of vapor is harmful and may cause heart irregularities, unconsciousness, or death. Misuse can be fatal. Vapor is heavier than air and reduces the amount of oxygen available for breathing. Product causes eye and skin irritation. Decomposition products are hazardous.

DO NOT USE OXYGEN to purge lines or to pressurize a machine for any purpose. Oxygen gas reacts violently with oil, grease, and other common substances.

NEVER EXCEED specified test pressures. VERIFY the allowable test pressure by checking the instruction literature and the design pressures on the equipment nameplate.

DO NOT USE air for leak testing. Use only refrigerant or dry nitrogen.

DO NOT VALVE OFF any safety device.

BE SURE that all pressure relief devices are properly installed and functioning before operating any machine.

⚠ WARNING

DO NOT WELD OR FLAMECUT any refrigerant line or vessel until all refrigerant *(liquid and vapor)* has been removed from chiller. Traces of vapor should be displaced with dry air or nitrogen and the work area should be well ventilated. *Refrigerant in contact with an open flame produces toxic gases.*

DO NOT USE eyebolts or eyebolt holes to rig machine sections or the entire assembly.

DO NOT work on high-voltage equipment unless you are a qualified electrician.

DO NOT WORK ON electrical components, including control centers, switches, starters, or oil heater (if applicable) until you are sure ALL POWER IS OFF and no residual voltage can leak from capacitors or solid-state components.

LOCK OPEN AND TAG electrical circuits during servicing. IF WORK IS INTERRUPTED, confirm that all circuits are deenergized before resuming work.

DO NOT syphon refrigerant.

AVOID SPILLING liquid refrigerant on skin or getting it into the eyes. USE SAFETY GOGGLES. Wash any spills from the skin with soap and water. If liquid refrigerant enters the eyes, IMMEDIATELY FLUSH EYES with water and consult a physician.

NEVER APPLY an open flame or live steam to a refrigerant cylinder. Dangerous over pressure can result. When it is necessary to heat refrigerant, use only warm (110 F [43 C]) water.

DO NOT REUSE disposable (nonreturnable) cylinders or attempt to refill them. It is DANGEROUS AND ILLEGAL. When cylinder is emptied, evacuate remaining gas pressure, loosen the collar, and unscrew and discard the valve stem. DO NOT INCINERATE.

CHECK THE REFRIGERANT TYPE before adding refrigerant to the machine. The introduction of the wrong refrigerant can cause damage or malfunction to this machine.

Operation of this equipment with refrigerants other than those cited herein should comply with ANSI/ASHRAE 15 (latest edition). Contact Carrier for further information on use of this machine with other refrigerants.

DO NOT ATTEMPT TO REMOVE fittings, covers, etc., while machine is under pressure or while machine is running. Be sure pressure is at 0 psig (0 kPa) before breaking any refrigerant connection.

CAREFULLY INSPECT all relief devices, rupture discs, and other relief devices AT LEAST ONCE A YEAR. If machine operates in a corrosive atmosphere, inspect the devices at more frequent intervals.

DO NOT ATTEMPT TO REPAIR OR RECONDITION any relief device when corrosion or build-up of foreign material (rust, dirt, scale, etc.) is found within the valve body or mechanism. Replace the device.

DO NOT install relief devices in series or backwards.

USE CARE when working near or in line with a compressed spring. Sudden release of the spring can cause it and objects in its path to act as projectiles.

⚠ CAUTION

DO NOT STEP on refrigerant lines. Broken lines can whip about and release refrigerant, causing personal injury.

DO NOT climb over a machine. Use platform, catwalk, or staging. Follow safe practices when using ladders.

USE MECHANICAL EQUIPMENT (crane, hoist, etc.) to lift or move inspection covers or other heavy components. Even if components are light, use mechanical equipment when there is a risk of slipping or losing your balance.

BE AWARE that certain automatic start arrangements CAN ENGAGE THE STARTER, TOWER FAN, OR PUMPS. Open the disconnect *ahead of* the starter, tower fan, or pumps. Shut off the machine or pump before servicing equipment.

USE only repair or replacement parts that meet the code requirements of the original equipment.

DO NOT VENT OR DRAIN waterboxes containing industrial brines, liquid, gases, or semisolids without the permission of your process control group.

DO NOT LOOSEN waterbox cover bolts until the waterbox has been completely drained.

DOUBLE-CHECK that coupling nut wrenches, dial indicators, or other items have been removed before rotating any shafts.

DO NOT LOOSEN a packing gland nut before checking that the nut has a positive thread engagement.

PERIODICALLY INSPECT all valves, fittings, and piping for corrosion, rust, leaks, or damage.

PROVIDE A DRAIN connection in the vent line near each pressure relief device to prevent a build-up of condensate or rain water.

Manufacturer reserves the right to discontinue, or change at any time, specifications or designs without notice and without incurring obligations.

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INTRODUCTION

Everyone involved in the start-up, operation, and maintenance of the 23XL machine should be thoroughly familiar with these instructions and other necessary job data before initial start-up. This book is outlined so that you may become familiar with the control system before performing start-up procedures. Procedures are arranged in the sequence required for proper machine start-up and operation.

⚠ WARNING

This unit uses a microprocessor control system. Do not short or jumper between terminations on circuit boards or modules; control or board failure may result.

Be aware of electrostatic discharge (static electricity) when handling or making contact with circuit boards or module connections. Always touch a chassis (grounded) part to dissipate body electrostatic charge before working inside control center.

Use extreme care when handling tools near boards and when connecting or disconnecting terminal plugs. Circuit boards can easily be damaged. Always hold boards by edges and avoid touching components and connections.

This equipment uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

Always store and transport replacement or defective boards in anti-static shipping bag.

ABBREVIATIONS AND EXPLANATIONS

Frequently used abbreviations in this manual include:

CCN	—	Carrier Comfort Network
CHWR	—	Common Chilled Water Return
CHWS	—	Common Chilled Water Supply
ECDW	—	Entering Condenser Water
ECW	—	Entering Chilled Water
HGBP	—	Hot Gas Bypass
I/O	—	Input/Output
LCD	—	Liquid Crystal Display
LCDW	—	Leaving Condenser Water
LED	—	Light-Emitting Diode
LID	—	Local Interface Device
LCW	—	Leaving Chilled Water
OLTA	—	Overload Trip Amps
PIC	—	Product Integrated Control
PSIO	—	Processor Sensor Input/Output Module
RLA	—	Rated Load Amps
SCR	—	Silicon Control Rectifier
SI	—	International System of Units
SMM	—	Starter Management Module

The 23XL machines use HCFC-22 and HFC-134a refrigerant. When referencing refrigerant charges in this manual, the HCFC-22 charge will be listed first and the HFC-134a value will be shown next to it in [ ].

Words printed in all capital letters or in italics may be viewed on the LID.

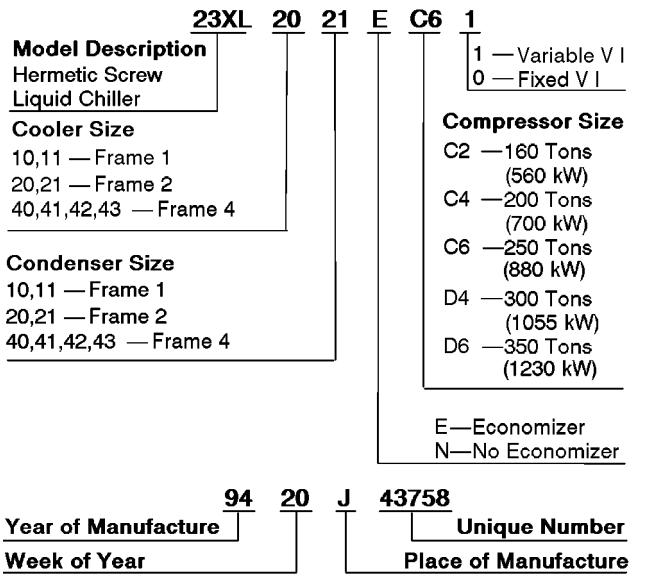
The front cover of the PSIO shows the software version it contains.

Factory installed additional components are called options in this manual. Factory supplied, field installed additional components are referred to as accessories.

23XL MACHINE FAMILIARIZATION (Fig. 1, 2A, and 2B)

Machine Identification Nameplate — The machine identification nameplate is located on the right side of the machine control panel center.

System Components — The components include cooler and condenser, heat exchangers in separate vessels, motor-compressor, lubrication package, control center, and optional motor starter. All connections from pressure vessels have external threads to enable each component to be pressure tested with a threaded pipe cap during factory assembly.

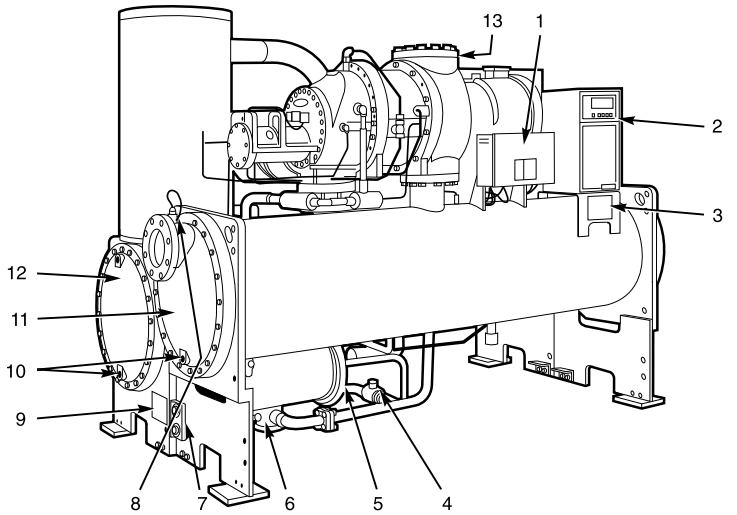


VI — Volumetric Index

SERIAL NUMBER BREAKDOWN

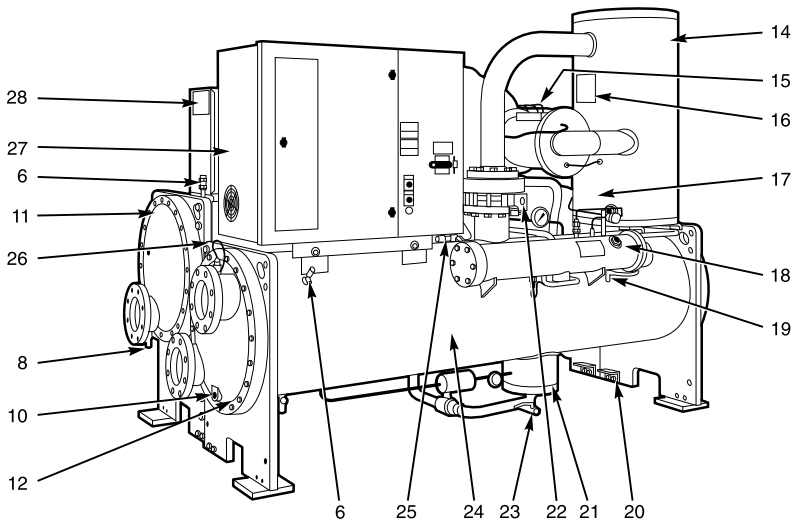
Fig. 1 — 23XL Identification

FRONT VIEW



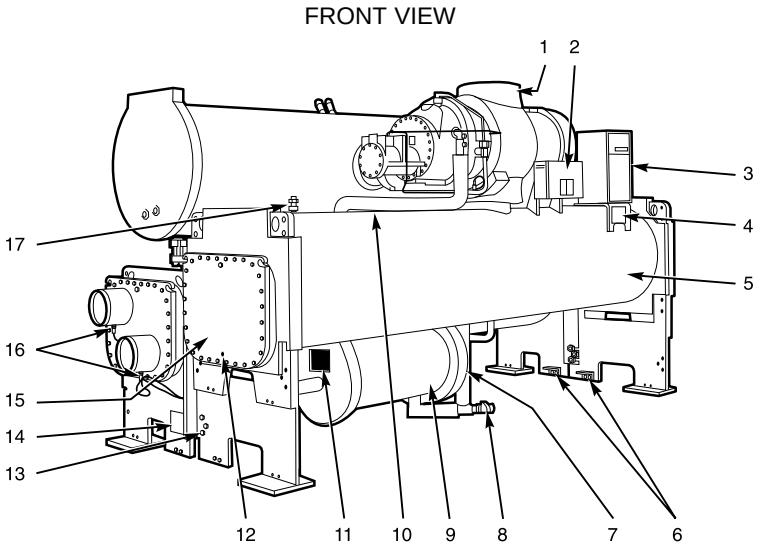
1 — Power Panel
2 — Local Interface Display (LID) Control Center
3 — ASME Nameplate, Cooler
4 — Cooler Refrigerant Isolation Valve
5 — ASME Nameplate, Economizer (Hidden)
6 — Service Valve
7 — Take-Apart Rabbet Fit Connector (Lower)
8 — Cooler Temperature Sensor
9 — ASME Nameplate, Condenser
10 — Typical Waterbox Drain Port
11 — Cooler Supply/Return End Waterbox Cover
12 — Condenser Supply/Return End Waterbox Cover
13 — Compressor Nameplate (Hidden)

REAR VIEW

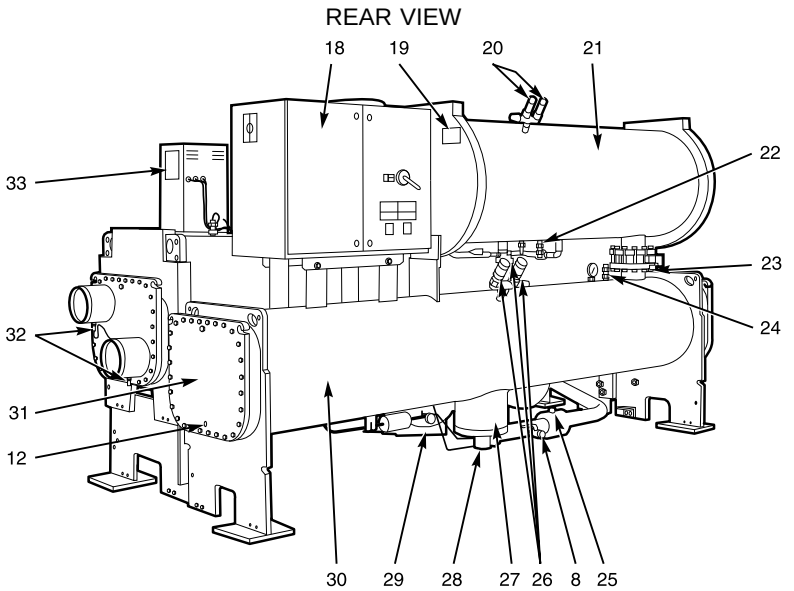


14 — Oil Separator
15 — ASME Nameplate, Muffler (Hidden)
16 — ASME Nameplate, Oil Separator
17 — Cooler Relief Valves (Hidden)
18 — Oil Sump Filter Assembly
19 — Oil Charging Valve
20 — Vessel Separation Feet
21 — Float Chamber
22 — Condenser Isolation Valve (Option or Accessory)
23 — Refrigerant Charging Valve
24 — Condenser
25 — Condenser Relief Valves (Hidden)
26 — Take-Apart Rabbet Fit Connector (Upper)
27 — Unit Mounted Starter (Option)
28 — Machine Identification Nameplate

Fig. 2A — Typical 23XL Installation (Frame 1 and 2 Machines)



1 — Compressor Nameplate (Hidden)
2 — Power Panel
3 — Local Interface Display (LID) Control Center
4 — ASME Nameplate, Cooler
5 — Cooler
6 — Vessel Separation Feet
7 — Economizer Float Valve Access Cover (Hidden)
8 — Refrigerant Charging Valve
9 — Economizer
10 — Oil Filter Assembly (Hidden)
11 — ASME Nameplate, Economizer
12 — Typical Waterbox Drain Port
13 — Take-Apart Rabbet Fit Connector
14 — ASME Nameplate, Condenser
15 — Cooler Supply/Return End Waterbox Cover
16 — Condenser Temperature Sensors
17 — Cooler Relief Valve



18 — Unit Mounted Starter (Option)
19 — ASME Nameplate, Oil Separator
20 — Oil Separator Relief Valves
21 — Oil Separator
22 — Oil Charging Valve
23 — Condenser Isolation Valve (Option or Accessory)
24 — Service Valve
25 — Cooler Refrigerant Isolation Valve
26 — Condenser Relief Valves and Oil Filter
27 — Float Chamber
28 — Poppet Valve Assembly
29 — Motor Cooling Isolation Valve
30 — Condenser
31 — Condenser Supply/Return End Waterbox Cover
32 — Cooler Temperature Sensors
33 — Machine Identification Nameplate

Fig. 2B — Typical 23XL Installation (Frame 4 Machine)

Cooler — This vessel (also known as the evaporator) is located underneath the compressor. The cooler is maintained at low temperature/pressure so that evaporating refrigerant can remove heat from water/brine flowing through its internal tubes.

Condenser — The condenser operates at a higher temperature/pressure than the cooler and has water flowing through its internal tubes to remove heat from the refrigerant.

Motor-Compressor — The motor-compressor maintains system temperature/pressure differences and moves the heat carrying refrigerant from the cooler to the condenser.

Muffler-Oil Separator — The muffler provides acoustical attenuation.

Refrigerant/oil separation is accomplished by the oil separator. Discharge gas enters near the midsection and leaves near the top, while the separated oil drains out through the bottom and flows through a horizontal oil sump/filter assembly (Frame 1 and 2 machines).

Frame 1 and 2 machines have an oil separator and a muffler assembly. On Frame 4 machines, the muffler is located inside the oil separator.

Control Center — The control center is the user interface for controlling the machine and regulating the machine's capacity to maintain the proper chilled water temperature. The control center:

- registers cooler, condenser, and lubricating system pressures
- shows machine operating condition and alarm shutdown conditions
- records the total machine operating hours, starts, and the number of hours the machine has been currently running
- sequences machine start, stop, and recycle under microprocessor control
- provides access to other Carrier Comfort Network devices

Factory-Mounted Starter (Optional Accessory) — The starter allows for the proper starting and disconnecting of electrical energy for the compressor-motor, oil heater (Frame 1 and 2 machines), and control center.

Storage Vessel (Optional) — Two sizes of storage vessels are available. The vessels have double relief valves, a magnetically coupled dial-type refrigerant level gage, a 1-in. FPT drain valve, and a ½-in. male flare vapor connection for the pumpout unit. A 30-in.-0-400 psi (-101-0-2750 kPa) gage is also supplied with each unit.

NOTE: If a storage vessel is not used at the jobsite, factory-installed optional isolation valves may be used to isolate the machine charge in either the cooler or condenser. An optional pumpout compressor system is used to transfer refrigerant from vessel to vessel.

REFRIGERATION CYCLE

The compressor continuously draws refrigerant vapor from the cooler. As the compressor suction reduces the pressure in the cooler, the remaining refrigerant boils at a fairly low temperature (typically 38 to 42 F [3 to 6 C]). The energy required for boiling is obtained from the water flowing through the cooler tubes. With heat energy removed, the water becomes cold enough for use in an air-conditioning circuit or process liquid cooling.

After taking heat from the water, the refrigerant vapor is compressed. Compression adds still more energy, and the refrigerant is quite warm (typically 130 to 160 F [54 to 71 C]) when it is discharged from compressor into condenser.

Relatively cool (typically 65 to 85 F [18 to 29 C]) water flowing into the condenser tubes removes heat from the refrigerant and the vapor condenses to liquid.

The liquid refrigerant passes through orifices into the FLASC (Flash Subcooler) chamber (Fig. 3 and 4). Since the FLASC chamber is at a lower pressure, part of the liquid refrigerant flashes to vapor, thereby cooling the remaining liquid. The FLASC vapor is recondensed on the tubes which are cooled by entering condenser water. The liquid then passes through a float valve assembly which forms a liquid seal to keep FLASC chamber vapor from entering the cooler.

An optional economizer can be installed between the condenser and cooler. In this case, the float valve meters the refrigerant liquid into the economizer. Pressure in this chamber is intermediate between condenser and cooler pressures. At this lower pressure, some of the liquid refrigerant flashes to gas, cooling the remaining liquid. The flash gas, having absorbed heat, is returned directly to the compressor at a point after suction cutoff (Fig. 5). Here it is mixed with gas from the suction cut-off point to produce an increase in the mass flow of refrigerant transported and compressed without either an increase in suction volume or a change in suction temperature. Rather than providing the same capacity with less power, the compressor provides substantially increased capacity with only a slight increase in power requirements.

The cooled liquid refrigerant in the economizer is metered through an orifice or linear float valve (depending upon machine design) into the cooler. Because pressure in the cooler is lower than economizer pressure, some of the liquid flashes and cools the remainder to evaporator (cooler) temperature. The cycle is now complete.

MOTOR COOLING CYCLE

The motor is cooled by liquid refrigerant taken from the bottom of the condenser vessel. The flow of refrigerant is maintained by the pressure differential that exists due to compressor operation. The refrigerant flows through an isolation valve, in-line filter/drier, and a sight glass/moisture indicator (dry-eye), into the motor through the motor spray nozzle. See Fig. 3 and 4.

The motor spray nozzle is orificed to control refrigerant flow through the gaps in the rotor and axial vent holes. The refrigerant collects in the bottom of the motor casing and then drains into the cooler through the motor cooling drain line.

The motor is protected by a temperature sensor imbedded in the stator windings. Motor temperatures above the MOTOR WINDING TEMPERATURE OVERRIDE THRESHOLD (see Capacity Overrides section, page 29) will override the chilled water temperature capacity control to hold. If the motor temperature rises 10 F (5.5 C) above this threshold, the slide valve will unload. If the motor temperature rises above the safety limit, the compressor will shut down.

LUBRICATION CYCLE

Summary — The 23XL does **not** require an oil pump. Oil flow is driven by differential pressure between condenser and evaporator. This system pressure difference holds the potential to push the oil through the oil separator and filter into the compressor rotors, bearings, and slide valve. The cycle is referred to as a ''high side'' oil system. See Fig. 3,4, and 5.

Details — The oil system:

- lubricates the roller bearings which support the male and female rotors, and the ball bearings of the 23XL compressor.

- positions the slide valve for capacity control. The slide valve is connected to a piston via a rod. The position of the piston, which rides in a cylinder, is determined by energizing one of two solenoids which function to supply and equalize oil pressure to and around the piston. This allows the slide valve to unload and load.
- seals the gap between the male and female rotors. The oil hydrodynamically seals this space to allow the refrigerant vapor to be compressed. A specific flow rate of oil is injected into the compressor rotor housing at the point where the compression process is initiated.
- cools the compressed refrigerant vapor. The oil that is injected into the compressor for sealing also acts as a heat sink by absorbing a portion of the heat from compression. Thus, constant and cool compressor discharge gas temperature, relative to an oil-less screw compressor, is maintained.

Oil is charged into the system through a hand valve located on the bottom of the oil sump (Frame 1 and 2 machines) or separator (Frame 4 machines). Sight glasses on the oil sump (Frame 1 and 2 machines) and/or oil separator (Frame 4 machines) permit oil level observation. When the compressor is shut down, an oil level should be visible in the oil sump (Frame 1 and 2 machines) or the lower oil separator sight glass (Frame 4 machines). During operation, the oil level should rise and be visible in the oil separator sight glass (Frame 1 and 2 machines) or the upper oil separator sight glass (Frame 4 machines). Approximately 4.2 gal. (15.9 L) of an oil and refrigerant mixture accumulates in the sump of Frame 1 and 2 machines. Approximately 10 gal (38 L) of oil accumulates in the separator and 2 gal. (7.6 L) accumulates on the cooler of Frame 4 machines.

Oil is driven from the oil separator through an oil filter to remove foreign particles. The oil filter has a replaceable cartridge. The filter housing is capable of being valved off to permit removal of the filter (see Maintenance sections, pages 63-68, for details). The oil then travels through a shutdown solenoid and past a pressure transducer to three separate inlets on the compressor. The oil pressure measured by the transducer is used to determine the oil pressure differential and pressure drop across the oil filter. The oil pressure differential is equal to the difference between the oil pressure transducer reading and the evaporator pressure transducer reading. It is read directly from the Local Interface Device (LID) default screen.

Part of the oil flow to the compressor is directed to the slide valve and is used for capacity control positioning. The remaining oil flow is divided between the rotors and bearings. A specific quantity is sent to the rotors and injected at the start of compression to seal the clearances between the rotors. Another portion is sent to the bearings and used for lubrication.

Oil leaves the compressor mixed with the compressed discharge refrigerant vapor. The mixture then enters the oil separator, where oil is removed from the refrigerant and collected at the bottom to complete the cycle.

FRAME 1 AND 2 MACHINES — The oil and refrigerant vapor mixture enters the oil separator through a nearly tangential nozzle, giving a rotational flow pattern. Oil is thrown to the sides of the oil separator and runs down the walls to a chamber in the bottom where it drains to the sump. A baffle separates this chamber from the vortex flow to prevent reentrainment. Gas flows up through a vortex funnel to a removable coalescing element where the rest of the oil collects. This oil runs down the element surface to a scavenge line which is piped to the first closed lobe port.

FRAME 4 MACHINES — The oil and refrigerant vapor mixture is directed against the rear wall of the oil separator as it enters the side of the oil separator. This action causes the bulk of the oil to drop from the refrigerant and collect at the bottom of the oil separator. A mesh screen is provided near the oil separator outlet to remove any additional oil which may still be entrained in the refrigerant vapor.

The oil sump (Frame 1 and 2 machines) contains a level switch, temperature sensor, 500-watt oil heater (Frame 1 and 2 machines), and oil filter. Oil temperature is measured and displayed on the LID default screen. During shutdown, oil temperature is maintained by the Product Integrated Control (PIC). See Oil Sump Temperature Control section on page 29.

NOTE: Frame 4 machines do not have an oil heater.

Operating oil pressure must be at least 20 psi (138 kPa) for HCFC-22 [7 psi (48.3 kPa) for HFC-134a] and is dependent upon system pressure differential (lift). The oil pressure transducer is located downstream of the filter, so the value displayed on the LID will be slightly less than the lift value. Under normal full load conditions, oil pressure is approximately 120 psi (827 kPa) [76 psi (517 kPa)]. If sufficient system differential pressure is not established or maintained, oil pressure will not be established (or will be lost) and machine shutdown will result.

The compressor provides a pressure differential, but the system pressure differential is constrained by the temperatures of the chilled and tower water circuits. Cold tower water, rapid tower water temperature swings, and high return water temperature are among the factors which could contribute to frequent **low oil pressure** alarms. To help ensure that suitable oil pressure is established at start-up, sufficient tower water control should exist. Increasing the machine ramp loading rate will allow faster compressor load up. This will quickly establish the refrigerant and, therefore, oil pressure differential. Units equipped with poppet valves provide a minimum pressure differential to ensure oil pressure at start-up. See the Troubleshooting Guide section on page 68 for further information.

Conversely, rapid loading of the compressor could cause any refrigerant in the oil to flash due to the sudden drop in suction pressure. If the resulting oil foam is not pumped efficiently, oil pressure drops and poor lubrication results. Therefore, the PIC control follows an internal oil pressure ramp loading schedule during initial start-up.

If the start-up oil pressure falls below the values specified in Table 1, the PIC control will shut down the machine.

Table 1 — Oil Pressure Ramp-Up Rate

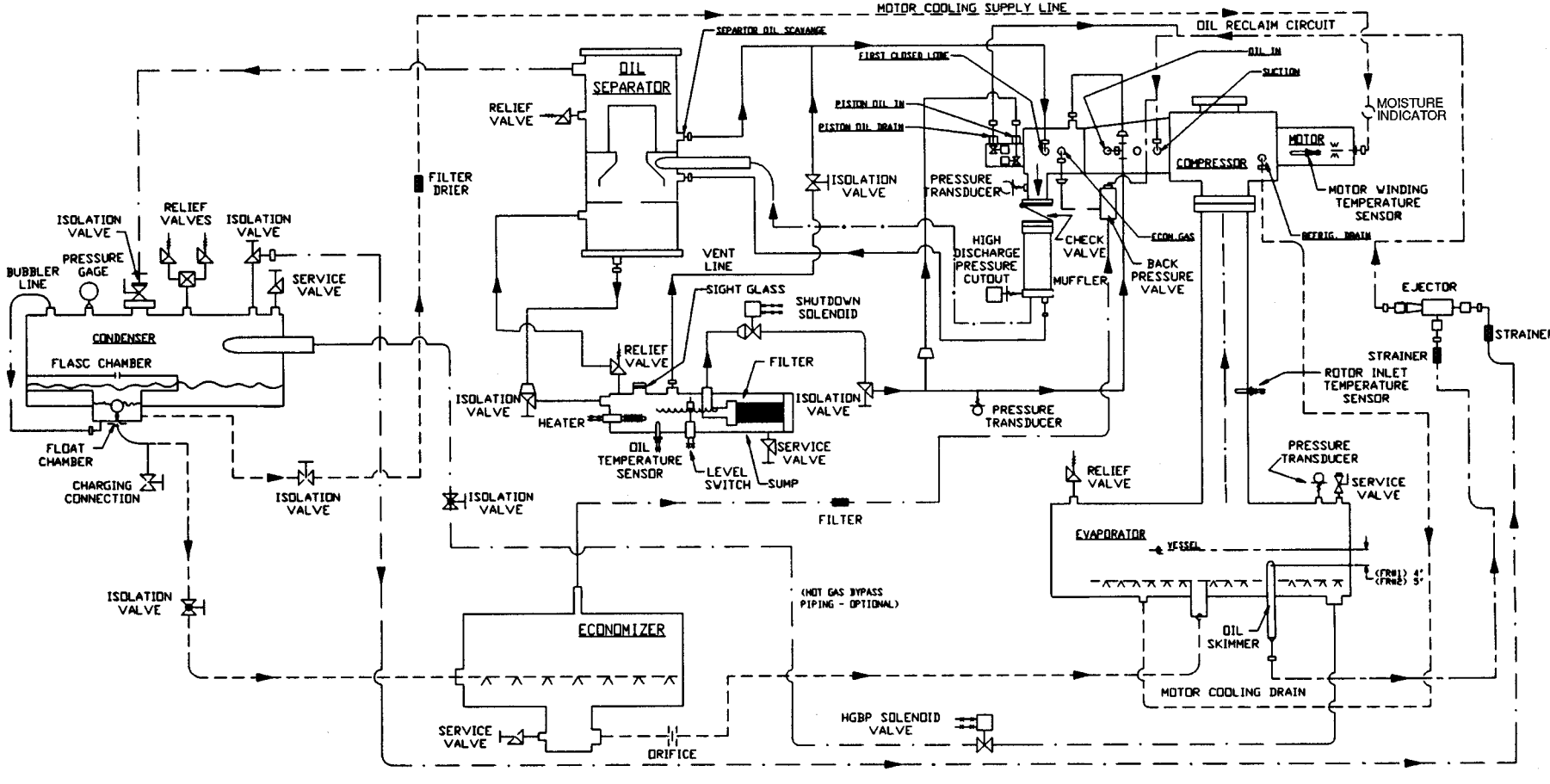
TIME (SEC)	MINIMUM START-UP OIL PRESSURE REQUIREMENT			
	HCFC-22		HFC-134a	
	psi	kPa	psi	kPa
40	4	27.6	1.4	9.7
80	11	75.8	4	27.6
120	20	137.9	7	48.3

Oil Reclaim System — The oil reclaim system operates to return oil from the cooler back to the compressor.

FRAME 1 AND 2 MACHINES — The oil reclaim system returns oil back to the compressor using discharge gas pressure to power an ejector. The oil and refrigerant mixture is vacuumed from the top of the cooler liquid refrigerant level and discharged into the compressor suction port.

FRAME 4 MACHINES — Frame 4 machines do not require an oil reclaim system.

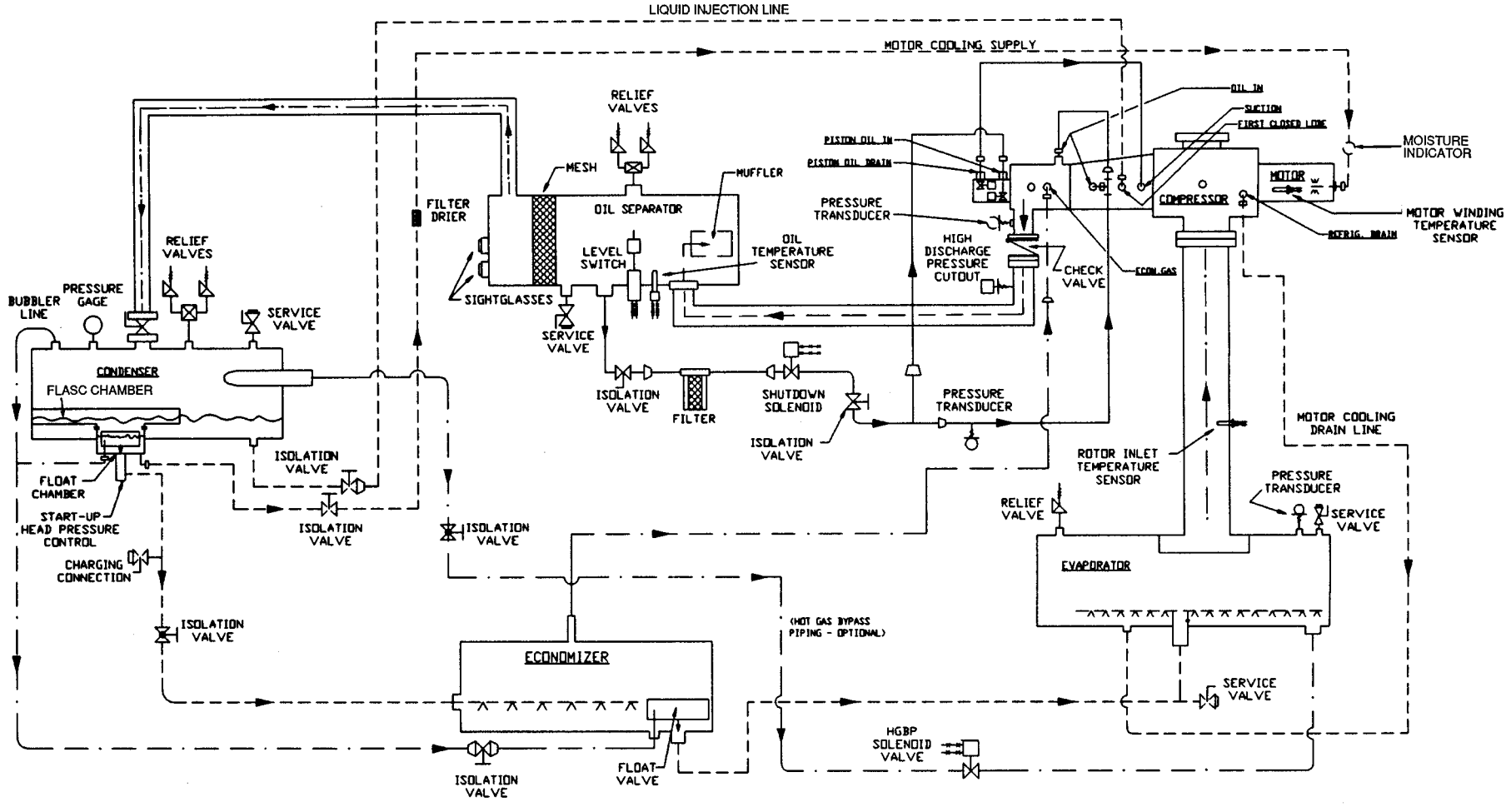
Oil Loss Prevention — The suction pan is located on top of the cooler, where oil collects during low-load operation. The cooler is designed so that when oil drains into the cooler from the compressor during low loads, it will be reentrained with the suction gas flow.



LEGEND

HGBP — Hot Gas Bypass
- - - - Refrigerant Liquid Flow
— · — · Refrigerant Vapor Flow
— — — Oil and Refrigerant Liquid Flow
— · — Oil and Refrigerant Vapor Flow
——— Oil Flow

Fig. 3 — Refrigerant Oil Flow Schematic (Frame 1 and 2 Machines)



LEGEND

HGBP — Hot Gas Bypass
Refrigerant Liquid Flow
Refrigerant Vapor Flow
Oil and Refrigerant Vapor Flow
Oil Flow

Fig. 4 — Refrigerant Oil Flow Schematic (Frame 4 Machines)

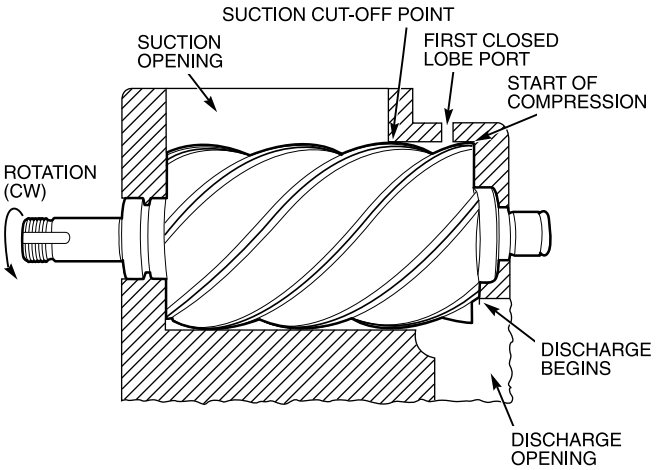


Fig. 5 — Screw Compressor Principle

In addition, the PIC Controls minimize oil loss to the cooler once the rotor inlet temperature sensor detects hot oil draining down the suction pipe.

If the rotor inlet temperature increases 4 F (2.2 C) on Frame 1 and 2 machines or 8 F (4.4 C) on Frame 4 machines above the leaving chilled water temperature, the slide valve is proportionately moved in the load direction to increase suction gas velocity. If the leaving chilled water temperature is then brought 5 F (2.8 C) below the control point temperature, the PIC will bring the machine into the recycle mode.

Slide Valve Principle — Oil flow to the slide piston is controlled by two solenoid valves. Each solenoid is operated by load and unload signals from the PIC control.

To unload the compressor, the unload solenoid valve is energized and the load solenoid valve is deenergized. This conducts high pressure oil to the cylinder, retracting the operator shaft, and modulating the slide valve toward the open position. See Fig. 6. The slide valve opening vents compressed gas back to the suction port on the compressor, retarding the start of the compression process.

To load the compressor, the unload solenoid valve is deenergized and the load solenoid valve is energized. This bleeds oil from the cylinder to the suction pressure area within the compressor housing. Forces resulting from the discharge-to-suction pressure differential are then allowed to push the slide valve toward the closed (fully loaded) position. See Fig. 7. When the slide valve is closed, the compressor pumps the maximum gas flow.

Extension and retraction of the operator shaft position the slide valve along the bottom of the rotors. The valve position controls the gas flow rate delivered by the compressor.

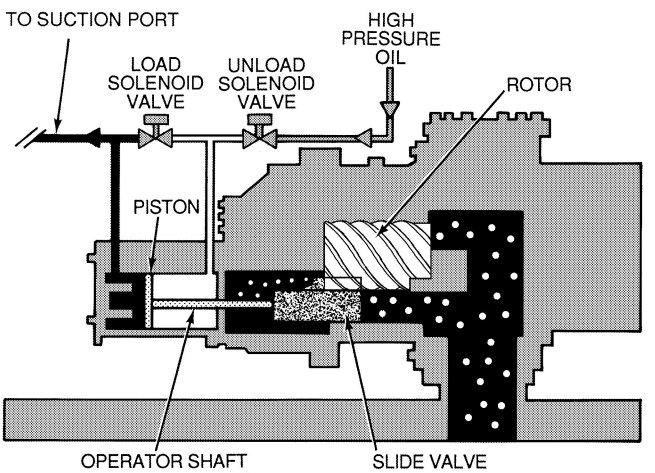


Fig. 6 — Slide Valve Position at Unload

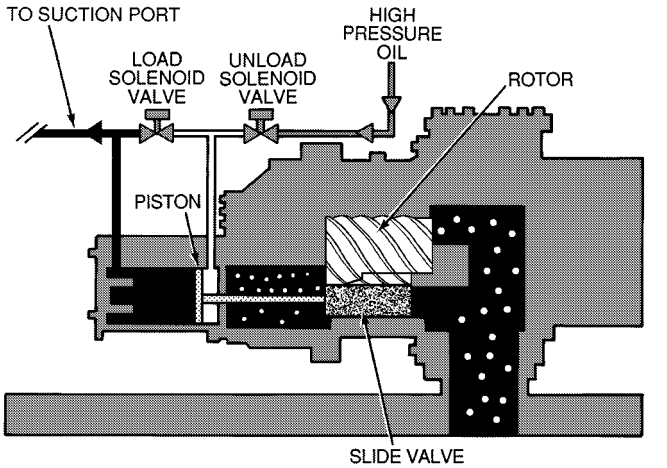


Fig. 7 — Slide Valve Position at Full Load

STARTING EQUIPMENT

The 23XL requires a motor starter to operate the hermetic compressor motor and various auxiliary equipment. The starter serves as the main field wiring interface for the contractor. Two types of unit mounted starters are available from Carrier Corporation: solid-state and wye-delta. See Carrier Specification Z-375 for specific starter requirements. All starters must meet these specifications in order to properly start and satisfy mechanical safety requirements. Starters may also be supplied as separate, free-standing units.

Inside the power panel are 3 separate circuit breakers. Circuit breaker CB1 is the compressor motor circuit breaker. The disconnect switch on the starter front cover is connected to this breaker.

⚠ WARNING

The main circuit breaker (CB1) on the front of the starter disconnects the main motor current only. Power is still energized for the other circuits. Another circuit breaker inside the starter must be turned off to disconnect power to PIC controls and oil heater (Frame 1 and 2 machines).

Circuit breaker CB2 supplies power to the control and oil heater power (Frame 1 and 2 machines) supply circuit breaker and portions of the starter controls.

All starters are shipped with a Carrier control module called the Starter Management Module (SMM). This module controls and monitors all aspects of the starter. See the Controls section on page 13 for additional SMM information. All starter replacement parts are supplied by the starter manufacturer.

Unit Mounted Solid-State Starter (Optional) — The 23XL may be equipped with a solid-state, reduced-voltage starter (Fig. 5, 8A, 8B, and 9). This starter provides on-off control of the compressor motor as its primary function. Using this type of starter reduces the peak starting torque, reduces the motor inrush current, and decreases mechanical shock. This is summed up by the phrase ‘‘soft starting.’’

Two varieties of solid-state starters are available as 23XL options (Carrier supplied and installed). When a solid-state starter is purchased with the 23XL, either a Benshaw, Inc. or a Cutler-Hammer® solid-state starter will be shipped with the unit. See Fig. 8A and 8B. The manufacturer’s name will be located inside the starter access door. See Fig. 9.

These starters operate by reducing the starting voltage. The starting torque of a motor at full voltage is typically 125% to 175% of the running torque. When the voltage and the current are reduced at start-up, the starting torque is reduced as well. The objective is to reduce the starting voltage to just the voltage necessary to develop the torque required to get the motor moving. The voltage and current are then ramped up in the desired period of time. The voltage is reduced through the use of silicon controlled rectifiers (SCR). Once full voltage is reached, a bypass contactor is energized to bypass the SCRs.

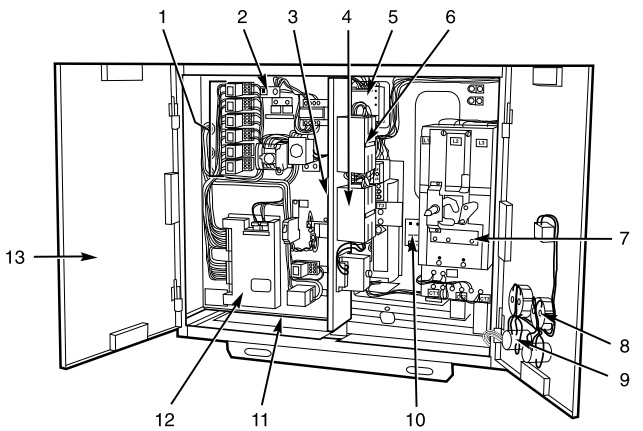
⚠ WARNING

When voltage is supplied to the solid-state circuitry, the heat sinks within the starter are at line voltage. Do not touch heat sinks while voltage is present or serious injury will result.

There are a number of LEDs (light-emitting diodes) that are useful in troubleshooting and starter check-out on the Benshaw, Inc. solid-state starters. These are used to indicate:

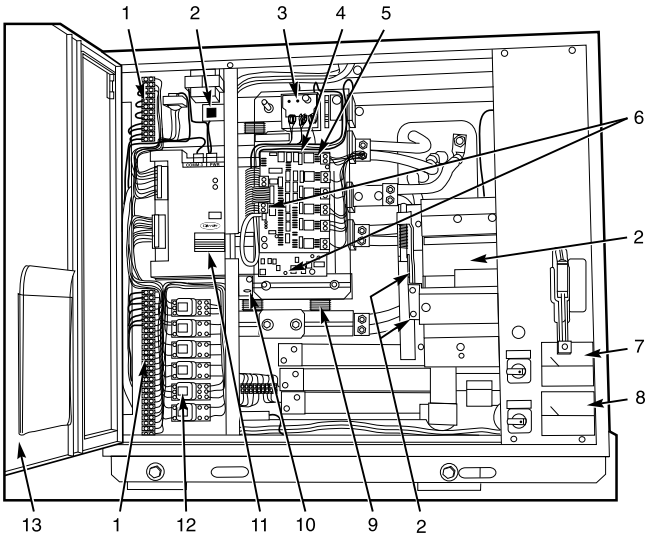
- voltage to the SCRs
- SCR control voltage
- power indication
- proper phasing for rotation
- start circuit energized
- overtemperature
- ground fault
- current unbalance
- run state

These LEDs (on Benshaw, Inc. solid-state starters) are further explained in the Check Starter and Troubleshooting Guide sections, pages 49 and 68.



1 — Pilot Relays (PR1 to PR5)
2 — Circuit Breaker 4
3 — Silicon Controlled Rectifier (SCR) (One of 6) (Hidden)
4 — Circuit Breaker 3
5 — Solid-State Controller
6 — Circuit Breaker 2
7 — Circuit Breaker 1
8 — Ammeter (Optional)
9 — Voltmeter (Optional)
10 — Overload Calibration Unit
11 — Field Wiring Terminal Strips (TB2 and TB3) (Hidden)
12 — Starter Management Module (SMM)
13 — Starter Access Door

Fig. 8A — Cutler-Hammer® Solid-State Starter, Internal View



1 — Field Wiring Terminal Strips (TB2 and TB3)
2 — Circuit Breakers 1, 2, 3, 4
3 — Overload Calibration Unit
4 — Solid-State Controller
5 — SCR LED (One of 6)
6 — Starter Fault and Run LEDs
7 — Voltmeter (Optional)
8 — Ammeter (Optional)
9 — Silicon Controlled Rectifier (SCR) (One of 6)
10 — Voltage LED
11 — Starter Management Module (SMM)
12 — Pilot Relays (PR1 to PR6)
13 — Starter Access Door

Fig. 8B — Benshaw, Inc. Solid-State Starter, Internal View

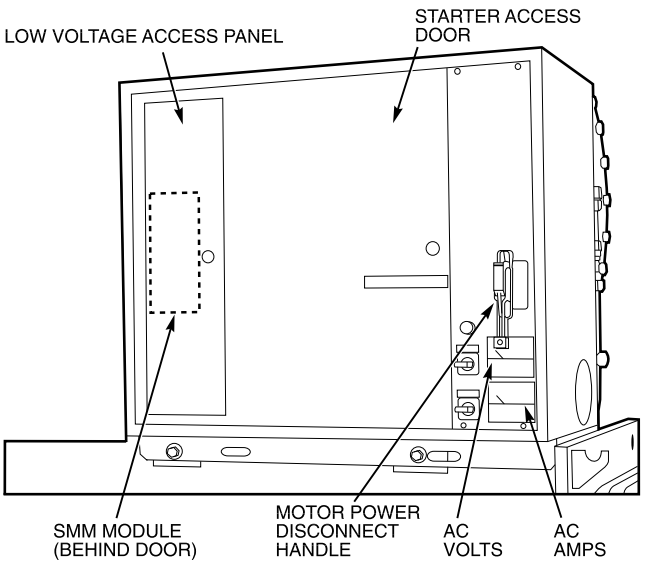


Fig. 9 — Typical Solid-State Starter, Front View

Unit Mounted Wye-Delta Starter (Optional) — The 23XL machine may be equipped with a wye-delta starter mounted on the unit. This starter is intended for use with low-voltage motors (under 600 v). It reduces the starting current inrush by connecting each phase of the motor windings into a wye configuration. This occurs during the starting period when the motor is accelerating up to speed. After a time delay, once the motor is up to speed, the starter automatically connects the phase windings into a delta configuration.

CONTROLS

Controls Definitions

ANALOG SIGNAL — *An analog signal* varies in proportion to the monitored source. It quantifies values between operating limits. (Example: A temperature sensor is an analog device because its resistance changes in proportion to the temperature, detecting many values.)

DIGITAL SIGNAL — *A digital (discrete) signal* is a two-position representation of the value of a monitored source. (Example: A switch is a digital device because it only indicates whether a value is above or below a set point or boundary by generating an on/off, high/low, or open/closed signal.)

VOLATILE MEMORY — *Volatile memory* is memory incapable of being sustained if power is lost and subsequently restored.

⚠ CAUTION

The memory of the PSIO and LID modules are volatile. If the battery in a module is removed or damaged, all programming will be lost.

General Controls Overview — The 23XL hermetic screw liquid chiller contains a microprocessor-based control center that monitors and controls all operations of the machine. The microprocessor control system matches the cooling capacity of the machine to the cooling load while providing state-of-the-art machine protection. The system controls cooling capacity within the set point plus the deadband by sensing the leaving chilled water or brine temperature and regulating the slide valve via a mechanically linked, hydraulically actuated piston. Movement of the slide valve alters the point during rotor travel at which compression begins and reduces the effective length of the compression cavities. This permits internal gas recirculation and reduces suction volume. Thus, smooth, stepless capacity regulation is provided without changing suction pressure. Closing of the slide valve increases capacity. Opening of the slide valve decreases capacity. See Fig. 10. Machine protection is provided by the processor, which monitors the digital and analog inputs and executes capacity overrides or safety shutdowns, if required.

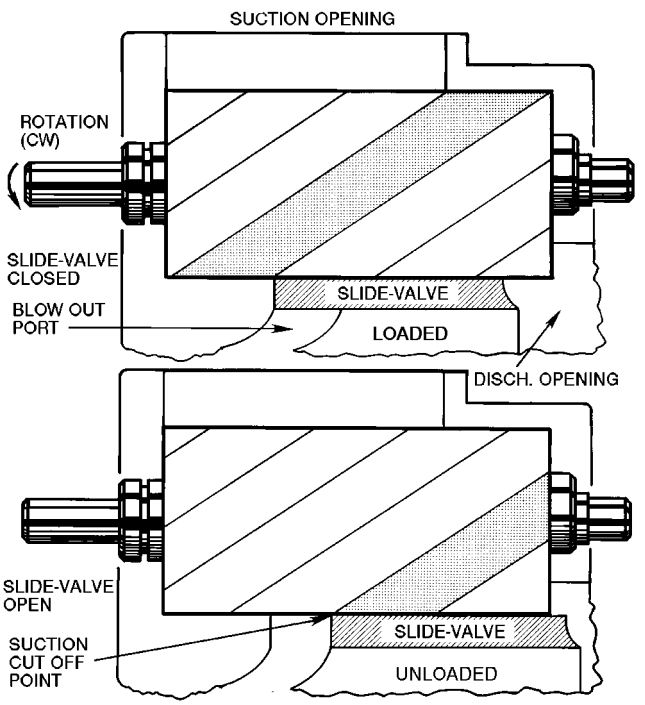


Fig. 10 — Slide-Valve Capacity Control

PIC System Components — The Product Integrated Control (PIC) is the machine's control system. The PIC controls the operation of the machine by monitoring all operating conditions. The PIC can also diagnose a problem with the machine. It promptly positions the slide valve to maintain leaving chilled water temperature. It can interface with auxiliary equipment such as pumps and cooling tower fans so that they turn on only when required. The PIC continually checks all safeties to prevent any unsafe operating condition. It also regulates the oil heater (Frame 1 and 2 machines) (while the compressor is off) and the hot gas bypass valve, (if installed).

The PIC can be interfaced with the Carrier Comfort Network (CCN) if desired. It can communicate with other PIC-equipped chillers and other CCN devices.

The PIC system consists of 3 modules housed inside three major components. The component names and the control voltage contained in each component include the following (also see Table 2 and Fig. 11-16):

- control center
  — all extra low-voltage wiring (24V or less)
- power panel
  — 230 or 115 control voltage (per job requirement)
- starter cabinet
  — machine power wiring (per job requirement)

Table 2 — Major PIC Components and Locations*

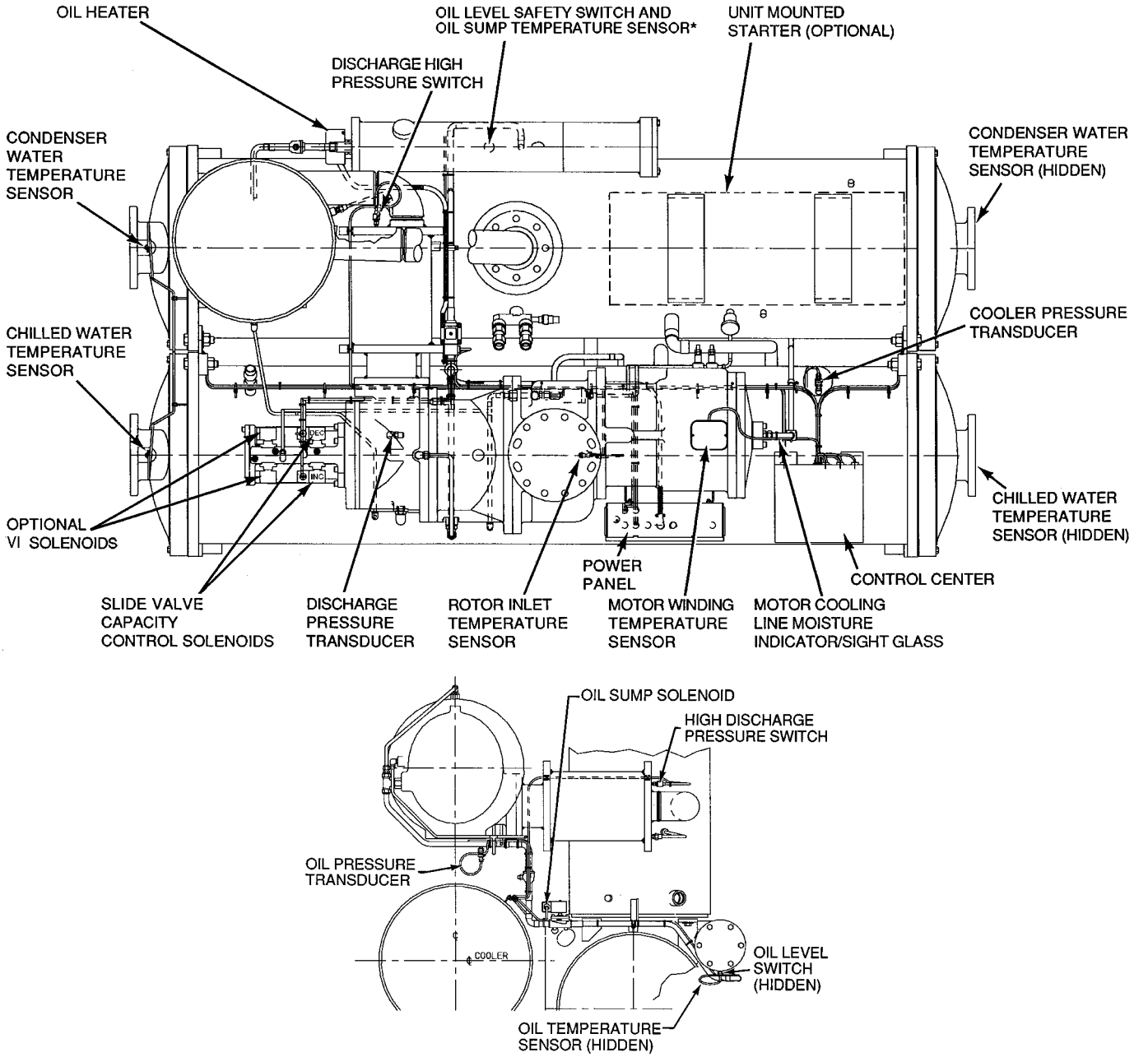
PIC COMPONENT	LOCATION
Processor Sensor Input/Output Module (PSIO)	Control Center
Starter Management Module (SMM)	Starter Cabinet
Local Interface Device (LID)	Control Center
6-Pack Relay Board	Control Center
8-Input Module (Optional)	Control Center
Oil Heater Contactor (1C) (Frame 1 and 2 Machines)	Power Panel
VI Contactor Relay (2C) (Optional)	Power Panel
Hot Gas Bypass Relay (3C) (Optional)	Power Panel
Control Transformers (T1-T4)	Power Panel
Control and Oil Heater Voltage Selector (S1)	Power Panel
Temperature Sensors	See Fig. 11,12, and 13
Pressure Transducers	See Fig. 11,12, and 14

VI — Volumetric Index

*See Fig. 8A, 8B, 9, 11, 12, 13, 14, 15, and 16.

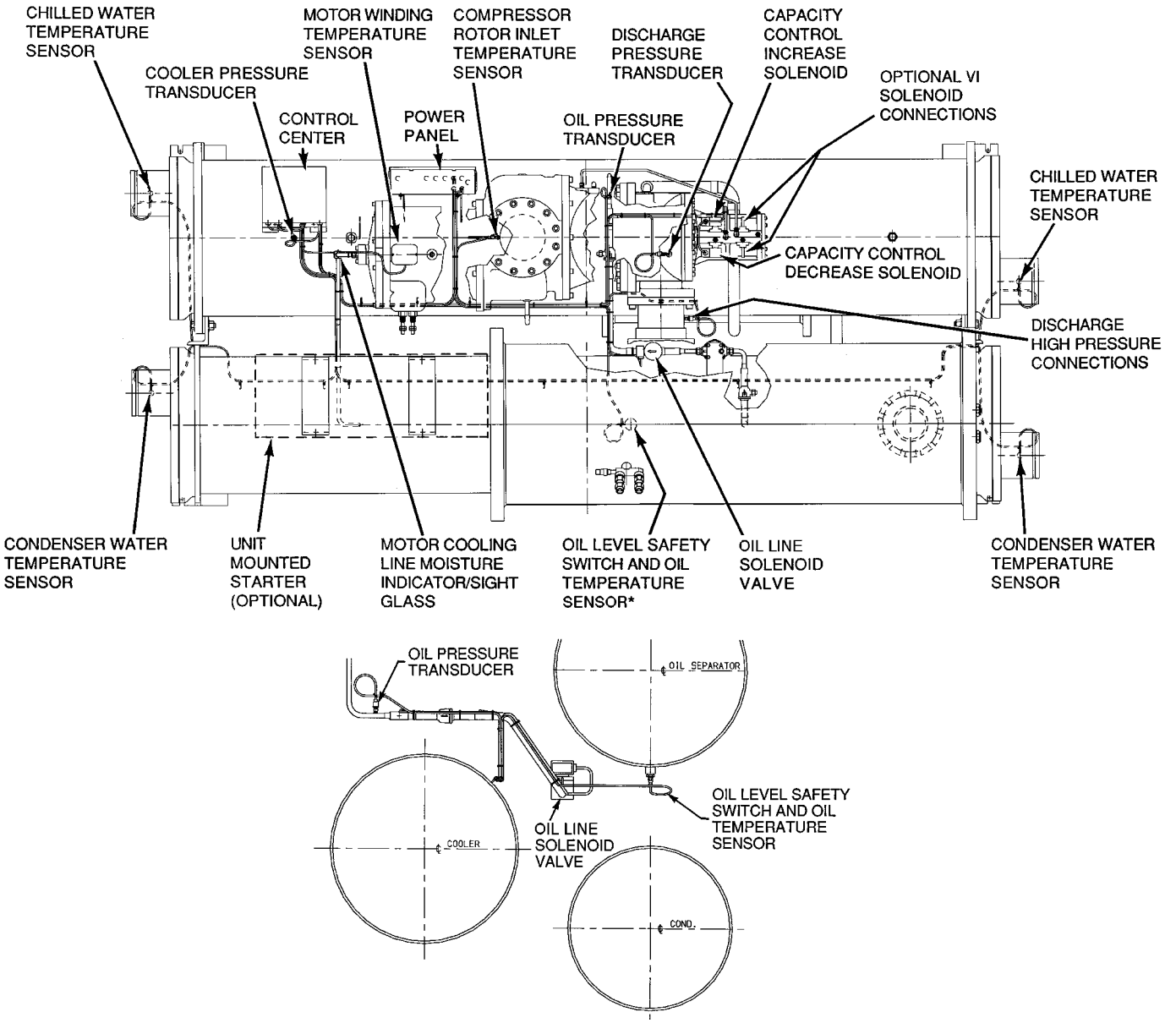
PROCESSOR SENSOR INPUT/OUTPUT MODULE (PSIO) — The PSIO is the brain of the PIC. This module contains all of the operating software needed to control the machine. The 23XL uses 3 pressure transducers and 8 thermistors to sense pressures and temperatures. These are connected to the PSIO module. The PSIO also provides outputs to the: slide valve assembly; oil heater (Frame 1 and 2 machines); hot gas bypass (optional); motor cooling solenoid; and space alarm contact. The PSIO communicates with the LID, the SMM, and the optional 8-input modules for user interface and starter management.

STARTER MANAGEMENT MODULE (SMM) — This module is located within the starter cabinet. This module implements PSIO commands for starter functions such as start/stop of the compressor, start/stop of the condenser and chilled water pumps, start/stop of the tower fan, spare alarm contacts, and the shunt trip. The SMM monitors starter inputs such as flow switches, line voltage, remote start contact, spare safety, compressor high discharge pressure, motor current signal, starter 1M and run contacts, and kW transducer input (optional). The SMM contains logic to safely shut down the machine if communications with the PSIO are lost.



*Some 23XL machines will have both an oil temperature sensor and an oil level safety switch (two separate components).

Fig. 11 — 23XL Control and Sensor Locations (Frame 1 and 2 Machines)



*Some 23XL machines will have both an oil temperature sensor and an oil level safety switch (two separate components).

Fig. 12 — 23XL Control and Sensor Locations (Frame 4 Machines)

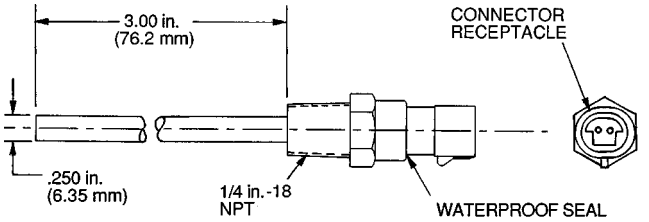


Fig. 13 — Control Sensors (Temperature)

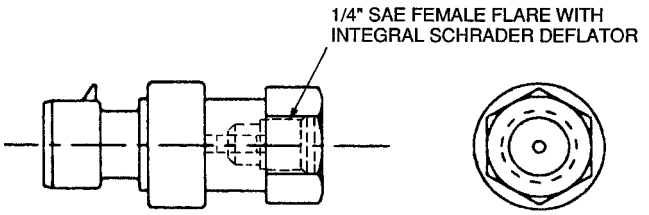
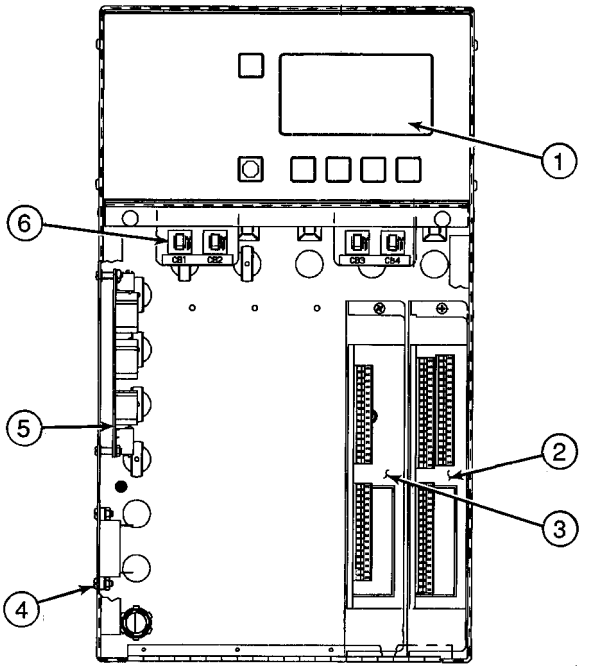


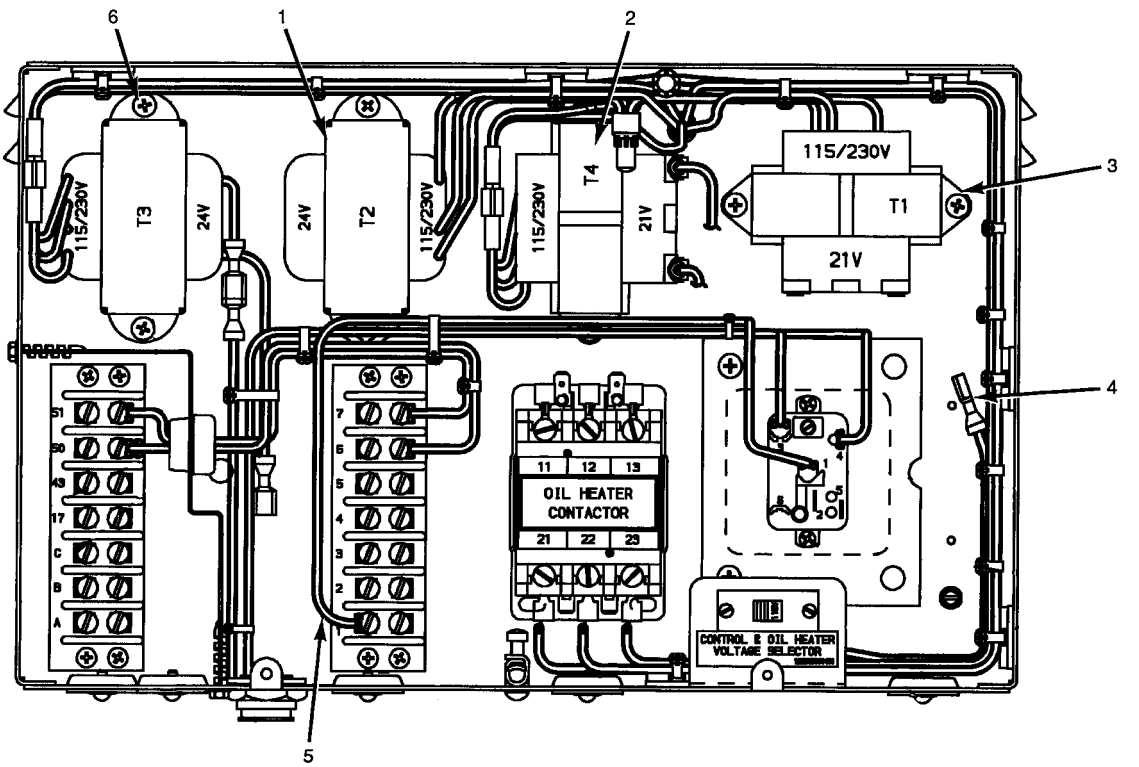
Fig. 14 — Control Sensors (Pressure Transducer, Typical)



LEGEND

1 — LID
2 — PSIO
3 — 8-Input Module (Optional) (one of two available)
4 — 5-Volt Transducer Power Supply
5 — 6-Pack Relay Board
6 — Circuit Breakers (4)

Fig. 15 — Control Panel (Front View), With Options Module



LEGEND

1 — T2 — 24 vac Power Transformer to: HGBP (Optional), oil heater (Frame 1 and 2 Machines), relays, oil level switch, oil solenoid valve, and capacity control solenoids
2 — T4 — 21 vac 8-Input Modules Transformer (Optional)
3 — T1 — 21 vac Control Center Transformer
4 — Optional HGBP Relay Connection
5 — Factory Terminal Connections
6 — T3 — 24 vac VI Solenoid Transformer (Optional)

NOTE: Oil heater contactor is only applicable to Frame 1 and 2 Machines.

Fig. 16 — Power Panel With Options

LOCAL INTERFACE DEVICE (LID) — The LID is mounted in the control center and allows the operator to interface with the PSIO or other CCN devices. It is the input center for all local machine set points, schedules, set up functions, and options. The LID has a stop button, an alarm light, 4 buttons for logic inputs, and a display. The function of the 4 buttons or ''softkeys'' are menu driven and are shown on the display directly above the keys.

6-PACK RELAY BOARD — This device is located in the control center and a cluster of 6 pilot relays, energized by the PSIO, for the oil heater (Frame 1 and 2 machines), spare alarm, optional hot gas bypass relay, and motor cooling solenoids.

8-INPUT MODULES (Optional) — One optional module is factory installed in the control center when ordered. There can be up to 2 of these modules per chiller with 8 spare inputs each. They are used whenever chilled water reset, demand reset, common supply/return sensors, or reading a spare sensor is required. The sensors or 4 to 20 mA signals are field installed.

The spare temperature sensors must have the same temperature/resistance curve as the other temperature sensors on this unit. These sensors are 5,000 ohm at 75 F (25 C).

OIL HEATER CONTACTOR RELAY (1C) (Frame 1 and 2 Only) — This contactor relay is located in the power panel and operates the heater at either 115 or 230 v. It is controlled by the PIC to maintain oil temperature during machine shutdown.

HOT GAS BYPASS RELAY (3C) (Optional) — This relay contactor located in the power panel, controls the opening of the hot gas bypass solenoid valve. The PIC energizes the relay during low load, low compression ratio conditions.

CONTROL TRANSFORMERS (T1-T4) — These transformers convert incoming control voltage to either 21-vac supply power for the PSIO module, LID, and options module, or 24-vac power supply for the power panel, control relays, 6-pack relay board, oil solenoid valve, oil level switch, slide valve solenoids, and VI (optional) actuator solenoids.

CONTROL AND OIL HEATER VOLTAGE SELECTOR (S1) — It is possible to utilize either 115 v or 230 v incoming control power in the power panel. The switch is set to the voltage used at the jobsite.

VARIABLE CONTACTOR RELAY (2C) (Optional) — This contactor relay is located in the power panel. The PIC energizes the relay to move the slide valve stop to the high VI position based on system compression ratio.

TEMPERATURE SENSORS — The temperature sensors sense the temperature of oil, refrigerant, water, and the motor throughout the machine.

PRESSURE TRANSDUCERS — The pressure transducers sense the pressure of oil and refrigerant throughout the machine.

LID Operation and Menus (Fig. 17 - 23)

GENERAL

- The LID display will automatically revert to the default screen after 15 minutes if no softkey activity takes place and if the machine is not in the PUMPDOWN mode (Fig. 17).
- When not showing the default screen, the upper right-hand corner of the LID always displays the name of the screen that you have entered (Fig. 18).
- The LID may be configured in English or SI units through the LID configuration screen.
- Local Operation — By pressing the LOCAL softkey, the PIC is now in the LOCAL operation mode, and the control will accept modification to programming from the LID only. The PIC will use the Local time schedule to determine machine start and stop times.
- CCN Operation — By pressing the CCN softkey, the PIC is now in the CCN operation mode. The control will accept modifications from any CCN interface or module with the proper authority, as well as the LID. The PIC will use the CCN time schedule to determine start and stop times.

ALARMS AND ALERTS — Alarm (*) and alert (!) status are indicated on the Status tables. An alarm (*) will shut down the compressor. An alert (!) notifies the operator that an unusual condition has occurred. The machine will continue to operate when an alert is shown.

Alarms are indicated when the control center alarm light (!) flashes on the LID panel. The alarm message is viewed on the default screen and an additional message and troubleshooting information are sent to the alarm history screen.

When an alarm is detected, the LID default screen will freeze (stop updating) at the time of alarm. The freeze enables the operator to view the machine conditions at the time of alarm. The Status tables will show the updated information. Once all alarms have been cleared (by pressing the RESET softkey), the default LID screen will return to normal operation.

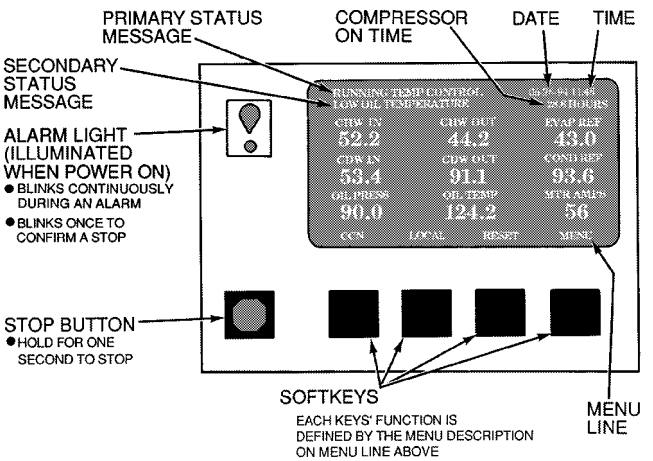

PRIMARY STATUS MESSAGE
COMPRESSOR ON TIME
DATE
TIME
SECONDARY STATUS MESSAGE
ALARM LIGHT (ILLUMINATED WHEN POWER ON)
● BLINKS CONTINUOUSLY DURING AN ALARM
● BLINKS ONCE TO CONFIRM A STOP
STOP BUTTON
● HOLD FOR ONE SECOND TO STOP
SOFTKEYS
EACH KEYS' FUNCTION IS DEFINED BY THE MENU DESCRIPTION ON MENU LINE ABOVE
MENU LINE

Fig. 17 — LID Default Screen

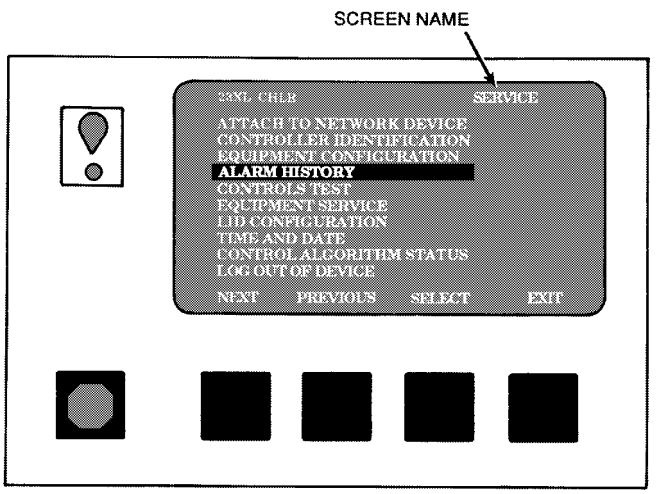
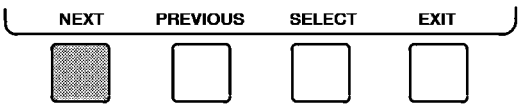


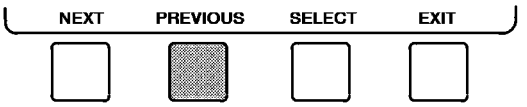
Fig. 18 — LID Service Screen

MENU STRUCTURE — To perform any of the operations described below, the PIC must be powered up and have successfully completed its self test.

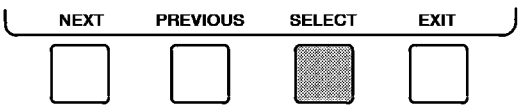
- Press NEXT to scroll the cursor bar down in order to highlight a point or to view more points below the current screen.



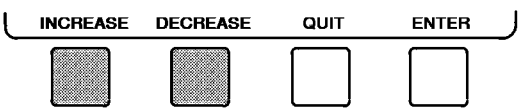
- Press PREVIOUS to scroll the cursor bar up in order to highlight a point or to view points above the current screen.



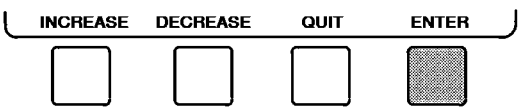
- Press SELECT to view the next screen level (highlighted with the cursor bar) or to override (if allowable) the highlighted point value.



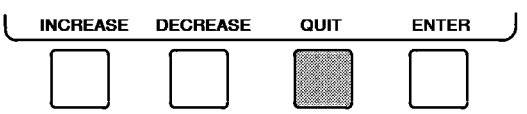
- Press INCREASE or DECREASE to change the highlighted point value.



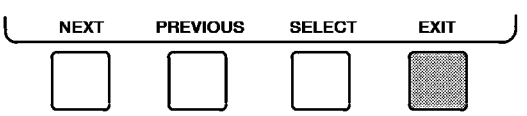
- Press ENTER to leave the selected decision or field and save changes.



- Press QUIT to leave the selected decision or field without saving any changes.

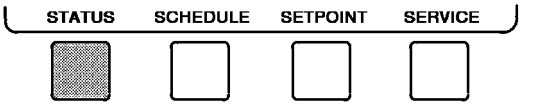


- Press EXIT to return to the previous screen level.

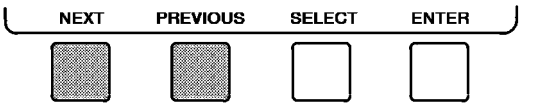


TO VIEW POINT STATUS (Fig. 19) — Point status is the actual value of all of the temperatures, pressures, relays, and actuators sensed and controlled by the PIC.

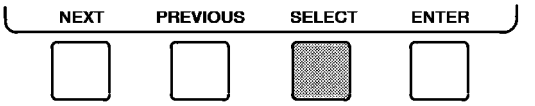
1. On the Menu screen, press STATUS to view the list of Point Status tables.



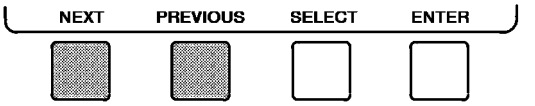
2. Press NEXT or PREVIOUS to highlight the desired status table. The list of tables includes:
   - Status01 — Status of control points and sensors
   - Status02 — Status of relays and contacts
   - Status03 — Status of both optional 8-input modules and sensors



3. Press SELECT to view the desired Point Status table.



4. On the Point Status screen press NEXT or PREVIOUS until desired point is displayed on the screen.



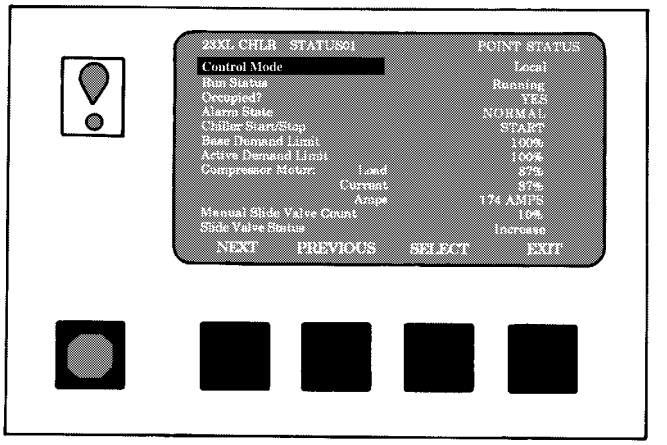
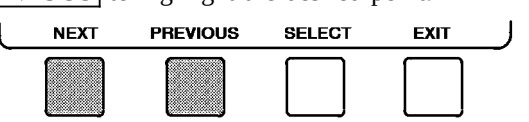


Fig. 19 — Example of Point Status Screen (Status01)

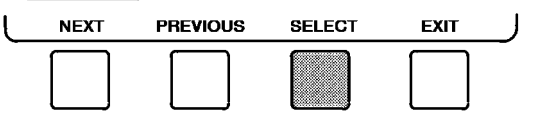
OVERRIDE OPERATIONS

<u>To Override a Value or Status</u>

1. On the Point Status table press NEXT or PREVIOUS to highlight the desired point.



2. Press SELECT to select the highlighted point. Then:



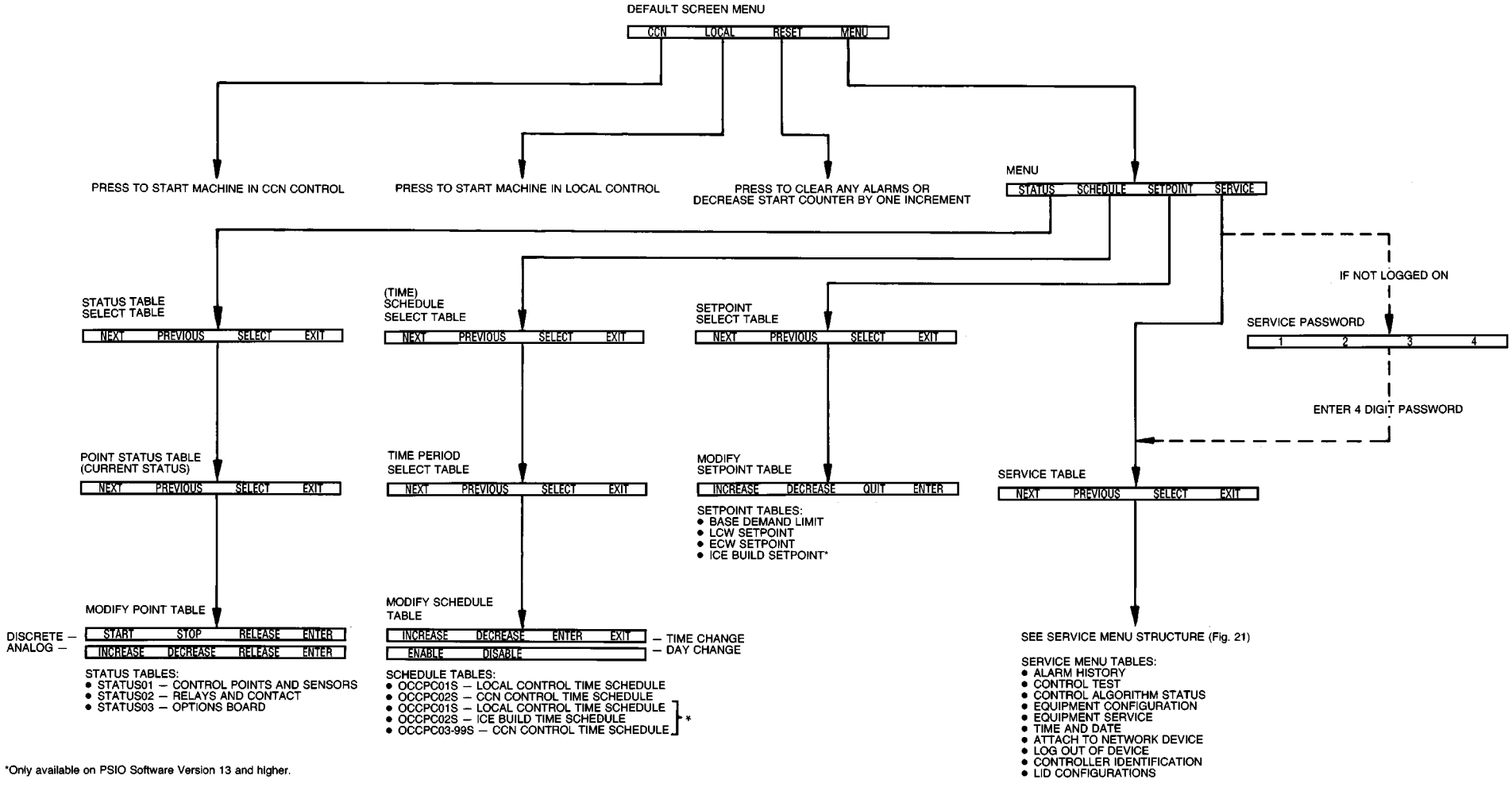

DEFAULT SCREEN MENU
CCN LOCAL RESET MENU
PRESS TO START MACHINE IN CCN CONTROL
PRESS TO START MACHINE IN LOCAL CONTROL
PRESS TO CLEAR ANY ALARMS OR DECREASE START COUNTER BY ONE INCREMENT
MENU
STATUS SCHEDULE SETPOINT SERVICE
IF NOT LOGGED ON
SERVICE PASSWORD
1 2 3 4
ENTER 4 DIGIT PASSWORD
STATUS TABLE SELECT TABLE
NEXT PREVIOUS SELECT EXIT
(TIME) SCHEDULE SELECT TABLE
NEXT PREVIOUS SELECT EXIT
SETPOINT SELECT TABLE
NEXT PREVIOUS SELECT EXIT
POINT STATUS TABLE (CURRENT STATUS)
NEXT PREVIOUS SELECT EXIT
TIME PERIOD SELECT TABLE
NEXT PREVIOUS SELECT EXIT
MODIFY SETPOINT TABLE
INCREASE DECREASE QUIT ENTER
SETPOINT TABLES:
• BASE DEMAND LIMIT
• LCW SETPOINT
• ECW SETPOINT
• ICE BUILD SETPOINT*
SERVICE TABLE
NEXT PREVIOUS SELECT EXIT
MODIFY POINT TABLE
DISCRETE —
START STOP RELEASE ENTER
ANALOG —
INCREASE DECREASE RELEASE ENTER
STATUS TABLES:
• STATUS01 — CONTROL POINTS AND SENSORS
• STATUS02 — RELAYS AND CONTACT
• STATUS03 — OPTIONS BOARD
MODIFY SCHEDULE TABLE
INCREASE DECREASE ENTER EXIT — TIME CHANGE
ENABLE DISABLE — DAY CHANGE
SCHEDULE TABLES:
• OCCPC01S — LOCAL CONTROL TIME SCHEDULE
• OCCPC02S — CCN CONTROL TIME SCHEDULE
• OCCPC01S — LOCAL CONTROL TIME SCHEDULE
• OCCPC02S — ICE BUILD TIME SCHEDULE
• OCCPC03-99S — CCN CONTROL TIME SCHEDULE
*
SEE SERVICE MENU STRUCTURE (Fig. 21)
SERVICE MENU TABLES:
• ALARM HISTORY
• CONTROL TEST
• CONTROL ALGORITHM STATUS
• EQUIPMENT CONFIGURATION
• EQUIPMENT SERVICE
• TIME AND DATE
• ATTACH TO NETWORK DEVICE
• LOG OUT OF DEVICE
• CONTROLLER IDENTIFICATION
• LID CONFIGURATIONS
*Only available on PSIO Software Version 13 and higher.

Fig. 20 — 23XL Menu Structure

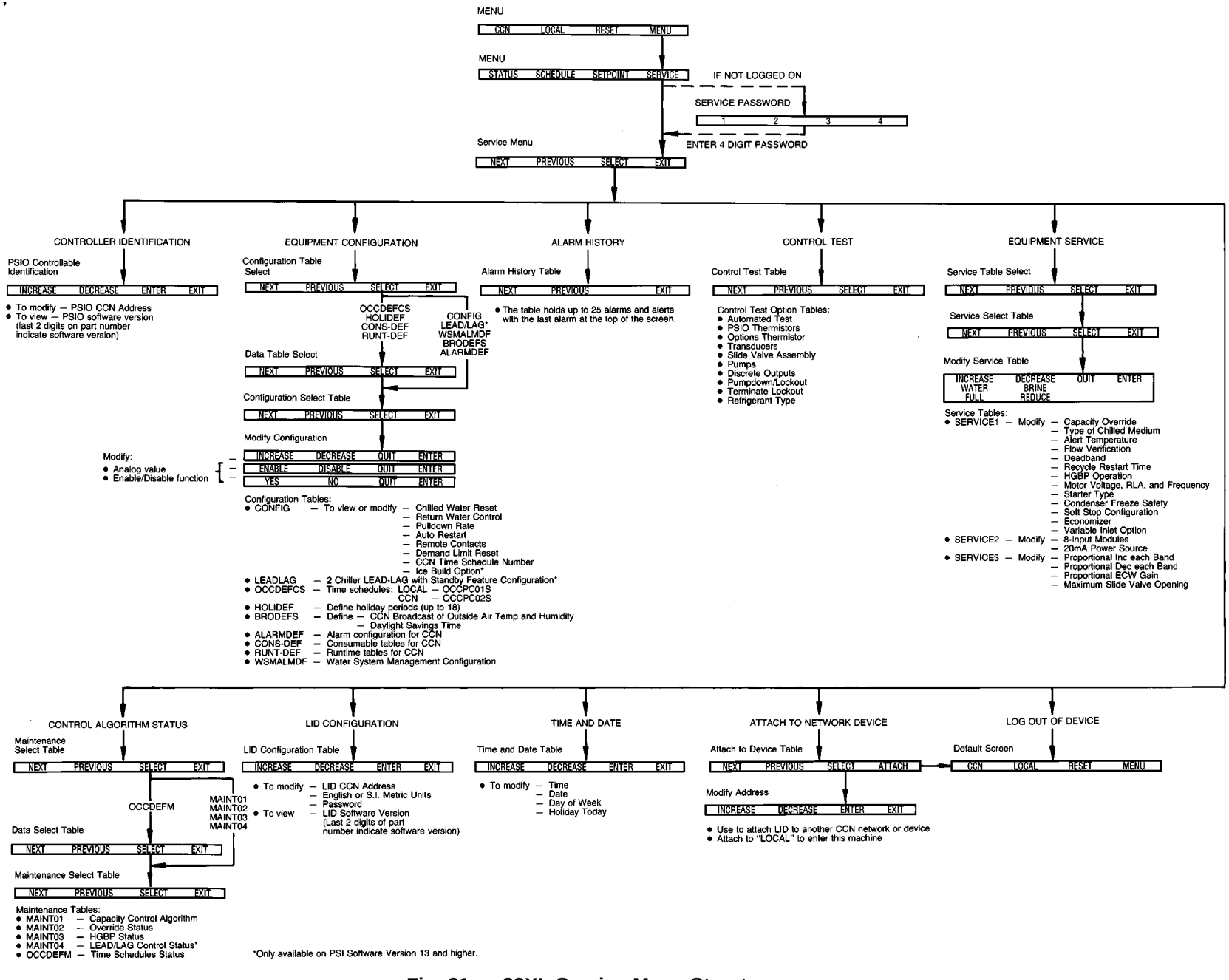
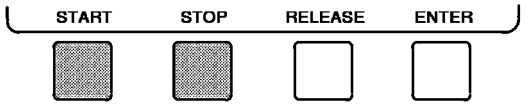
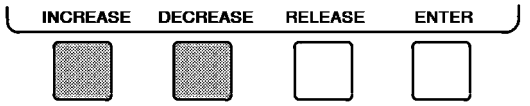

MENU
CCN LOCAL RESET MENU
MENU
STATUS SCHEDULE SETPOINT SERVICE
IF NOT LOGGED ON
SERVICE PASSWORD
1 2 3 4
ENTER 4 DIGIT PASSWORD
Service Menu
NEXT PREVIOUS SELECT EXIT
CONTROLLER IDENTIFICATION
PSIO Controllable Identification
INCREASE DECREASE ENTER EXIT
• To modify — PSIO CCN Address
• To view — PSIO software version (last 2 digits on part number indicate software version)
EQUIPMENT CONFIGURATION
Configuration Table Select
NEXT PREVIOUS SELECT EXIT
OCCDEFCS HOLIDEF CONS-DEF RUNT-DEF
CONFIG LEAD/LAG* WSMALMDF BRODEFS ALARMDEF
Data Table Select
NEXT PREVIOUS SELECT EXIT
Configuration Select Table
NEXT PREVIOUS SELECT EXIT
Modify Configuration
INCREASE DECREASE QUIT ENTER
ENABLE DISABLE QUIT ENTER
YES NO QUIT ENTER
Modify:
• Analog value
• Enable/Disable function
Configuration Tables:
• CONFIG — To view or modify — Chilled Water Reset
— Return Water Control
— Pulldown Rate
— Auto Restart
— Remote Contacts
— Demand Limit Reset
— CCN Time Schedule Number
— Ice Build Option*
• LEADLAG — 2 Chiller LEAD-LAG with Standby Feature Configuration*
• OCCDEFCS — Time schedules: LOCAL — OCCPC01S
CCN — OCCPC02S
• HOLIDEF — Define holiday periods (up to 18)
• BRODEFS — Define — CCN Broadcast of Outside Air Temp and Humidity
— Daylight Savings Time
• ALARMDEF — Alarm configuration for CCN
• CONS-DEF — Consumable tables for CCN
• RUNT-DEF — Runtime tables for CCN
• WSMALMDF — Water System Management Configuration
ALARM HISTORY
Alarm History Table
NEXT PREVIOUS EXIT
• The table holds up to 25 alarms and alerts with the last alarm at the top of the screen.
CONTROL TEST
Control Test Table
NEXT PREVIOUS SELECT EXIT
Control Test Option Tables:
• Automated Test
• PSIO Thermistors
• Options Thermistor
• Transducers
• Slide Valve Assembly
• Pumps
• Discrete Outputs
• Pumpdown/Lockout
• Terminate Lockout
• Refrigerant Type
EQUIPMENT SERVICE
Service Table Select
NEXT PREVIOUS SELECT EXIT
Service Select Table
NEXT PREVIOUS SELECT EXIT
Modify Service Table
INCREASE WATER FULL DECREASE BRINE REDUCE QUIT ENTER
Service Tables:
• SERVICE1 — Modify — Capacity Override
— Type of Chilled Medium
— Alert Temperature
— Flow Verification
— Deadband
— Recycle Restart Time
— HGBP Operation
— Motor Voltage, RLA, and Frequency
— Starter Type
— Condenser Freeze Safety
— Soft Stop Configuration
— Economizer
— Variable Inlet Option
• SERVICE2 — Modify — 8-Input Modules
— 20mA Power Source
• SERVICE3 — Modify — Proportional Inc each Band
— Proportional Dec each Band
— Proportional ECW Gain
— Maximum Slide Valve Opening
CONTROL ALGORITHM STATUS
Maintenance Select Table
NEXT PREVIOUS SELECT EXIT
OCCDEFM
MAINT01 MAINT02 MAINT03 MAINT04
Data Select Table
NEXT PREVIOUS SELECT EXIT
Maintenance Select Table
NEXT PREVIOUS SELECT EXIT
Maintenance Tables:
• MAINT01 — Capacity Control Algorithm
• MAINT02 — Override Status
• MAINT03 — HGBP Status
• MAINT04 — LEAD/LAG Control Status*
• OCCDEFM — Time Schedules Status
LID CONFIGURATION
LID Configuration Table
INCREASE DECREASE ENTER EXIT
• To modify — LID CCN Address
— English or S.I. Metric Units
— Password
• To view — LID Software Version (Last 2 digits of part number indicate software version)
TIME AND DATE
Time and Date Table
INCREASE DECREASE ENTER EXIT
• To modify — Time
— Date
— Day of Week
— Holiday Today
ATTACH TO NETWORK DEVICE
Attach to Device Table
NEXT PREVIOUS SELECT ATTACH
Modify Address
INCREASE DECREASE ENTER EXIT
• Use to attach LID to another CCN network or device
• Attach to "LOCAL" to enter this machine
LOG OUT OF DEVICE
Default Screen
CCN LOCAL RESET MENU
*Only available on PSI Software Version 13 and higher.

Fig. 21 — 23XL Service Menu Structure

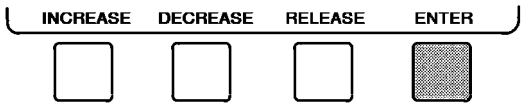
For Discrete Points — Press [START] or [STOP] to select the desired state.



For Analog Points — Press [INCREASE] or [DECREASE] to select the desired value.



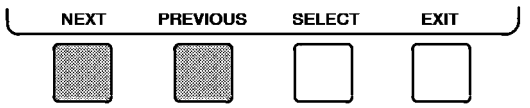
3. Press [ENTER] to register new value.



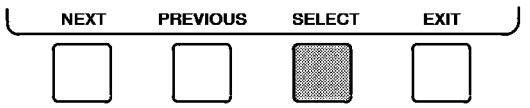
NOTE: When overriding or changing metric values, it is necessary to hold the softkey down for a few seconds in order to see a value change, especially on kilopascal values.

To Remove an Override

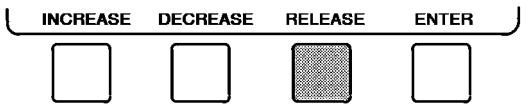
1. On the Point Status table press [NEXT] or [PREVIOUS] to highlight the desired point.



2. Press [SELECT] to access the highlighted point.



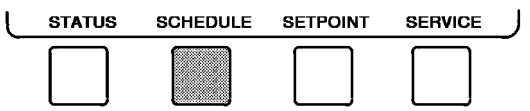
3. Press [RELEASE] to remove the override and return the point to the PIC's automatic control.



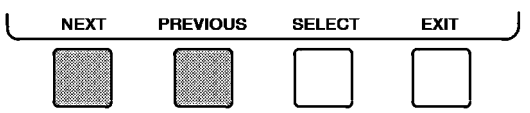
Override Indication — An override value is indicated by "SUPVSR", "SERVC", or "BEST" flashing next to the point value on the Status table.

TIME SCHEDULE OPERATION (Fig. 22)

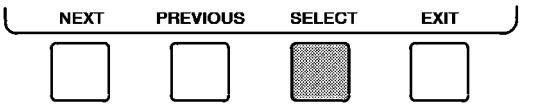
1. On the Menu screen, press [SCHEDULE].



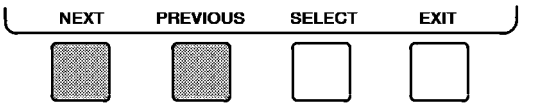
2. Press [NEXT] or [PREVIOUS] to highlight the desired schedule. When using PSIO Software Version 8 or 12, OCCPC01S is the LOCAL Time Schedule and OCCPC02S is the CCN Time Schedule. When using PSIO Software Version 13 and higher, OCCPC01S is the LOCAL Time Schedule, OCCPC02S is the Ice Build Time Schedule, and OCCPC03S is the CCN Time Schedule (the actual CCN Occupied Schedule number is defined on the Config table). The schedule number can change to any value from 03 to 99.



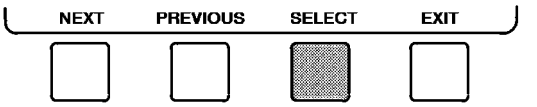
3. Press [SELECT] to access and view the time schedule.



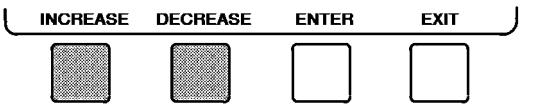
4. Press [NEXT] or [PREVIOUS] to highlight the desired period or override that you wish to change.



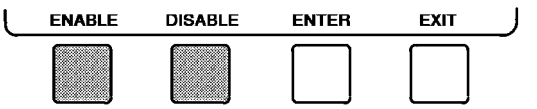
5. Press [SELECT] to access the highlighted period or override.



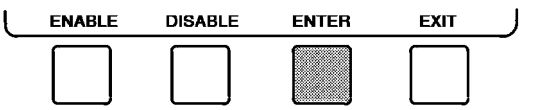
6. a. Press [INCREASE] or [DECREASE] to change the time values. Override values are in one-hour increments, up to 4 hours.



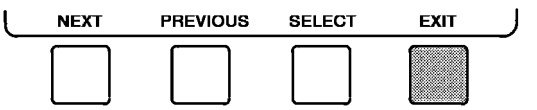
b. Press [ENABLE] to select days in the day-of-week fields. Press [DISABLE] to eliminate days from the period.



7. Press [ENTER] to register the values and to move horizontally (left to right) within a period.



8. Press [EXIT] to leave the period or override.



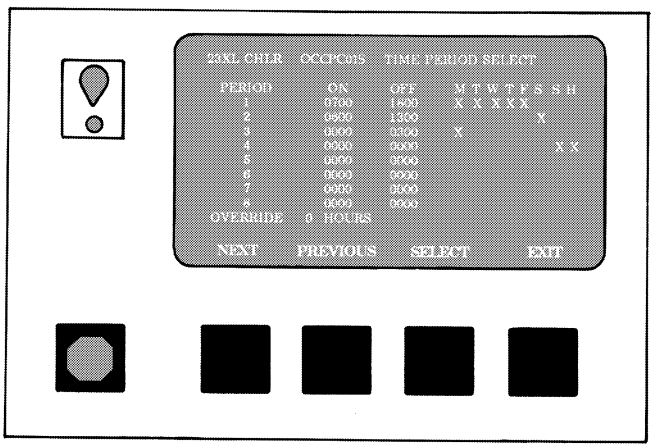
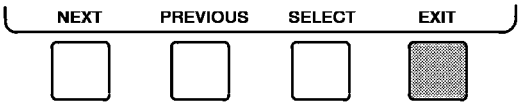


Fig. 22 — Example of Time Schedule Operation Screen

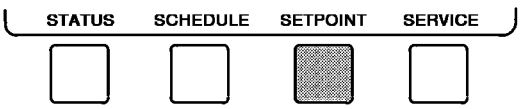
9. Either return to Step 4 to select another period or over ride or press EXIT again to leave the current time schedule screen and save the changes.



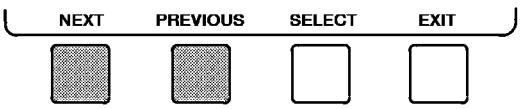
10. Holiday Designation may be found in the Service Operation section, page 36. You must assign the month, day, and duration for the holiday. The Broadcast function in the Brodefs table also must be enabled for holiday periods to function.

TO VIEW AND CHANGE SET POINTS (Fig. 23)

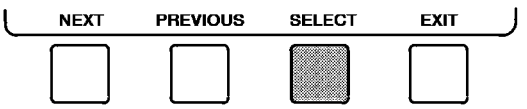
1. To view the Set Point table, at the Menu screen press SETPOINT.



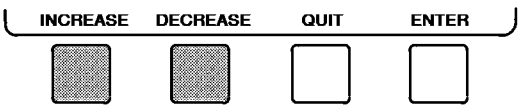
2. There are 4 set points on this table: Base Demand Limit; LCW Set Point (leaving chilled water set point); ECW Set Point (entering chilled water set point); and ICE BUILD Set Point (PSIO Software Version 13 or higher). Only one of the chilled water set points can be active at any time. The type of set point and the ICE BUILD CONFIGURATION are activated in the Service menu.
3. Press NEXT or PREVIOUS to highlight the desired set point entry.



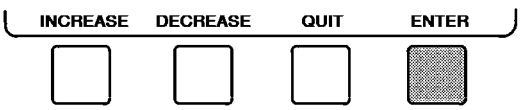
4. Press SELECT to modify the highlighted set point.



5. Press INCREASE or DECREASE to change the selected set point value.



6. Press ENTER to save the changes and return to the previous screen.



SERVICE OPERATION — To view the menu-driven programs available for Service Operation, see Service Operation section, page 36. For examples of LID display screens, see Table 3.

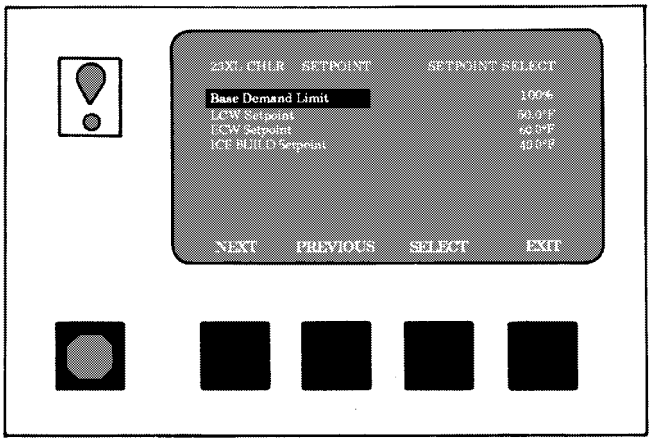


Fig. 23 — Example of Set Point Screen

PIC System Functions

NOTE: Throughout this manual, words printed in capital letters and italics are values that may be viewed on the LID. Operating values for HFC-134a refrigerant, when applicable, follow the HCFC-22 value and are enclosed in brackets. See Table 3 for examples of LID screens. Point names are listed in the Description column. An overview of LID operation and menus is given in Fig. 17-23.

CAPACITY CONTROL — The PIC controls the machine capacity by modulating the slide valve in response to chilled water temperature changes away from the *CONTROL POINT.* The *CONTROL POINT* may be changed by a CCN network device, or is determined by the PIC adding any active chilled water reset to the chilled water *SETPOINT.* The PIC uses the *PROPORTIONAL INC (Increase) BAND, PROPORTIONAL DEC (Decrease) BAND,* and the *PROPORTIONAL ECW (Entering Chilled Water) GAIN* to determine how fast or slow to respond. *CONTROL POINT* may be viewed/overridden on the Status table Status01 selection.

ENTERING CHILLED WATER CONTROL — If this option is enabled, the PIC uses *ENTERING CHILLED WATER* temperature to modulate the slide valve instead of *LEAVING CHILLED WATER* temperature. *ENTERING CHILLED WATER* control option may be viewed/modified on the Equipment Configuration table Config selection.

DEADBAND — This is the tolerance on the chilled water/brine temperature *CONTROL POINT.* If the water temperature goes outside of the *DEADBAND,* the PIC opens or closes the slide valve in response until it is within tolerance. The PIC may be configured with a 0.5 to 2° F (0.3 to 1.1° C) DEADBAND. *DEADBAND* may be viewed or modified on the Equipment Service table, Service1 table.

For example, a 1 F (0.6 C) deadband setting controls the water temperature within ±0.5° F (0.3° C) of the control point. This may cause frequent slide valve movement if the chilled water load fluctuates frequently. A setting of 1 F (0.6 C) is the default setting.

PROPORTIONAL BANDS AND GAIN — Proportional band is the rate at which the slide valve position is corrected in proportion to how far the CHILLED WATER/BRINE temperature is from the control point. Proportional gain determines how quickly the slide valve reacts to how quickly the temperature is moving from *CONTROL POINT.*

The proportional band can be viewed/modified on the LID. There are two response modes, one for temperature response above the control point, the other for response below the control point.

The first type is called *PROPORTIONAL INC BAND* and it can slow or quicken slide valve response to chilled water/brine temperature above *DEADBAND*. The *PROPORTIONAL INC BAND* can be adjusted from a setting of 5 to 10; the default setting is 6.5. *PROPORTIONAL DEC BAND* can slow or quicken slide valve response to chilled water temperature below control point plus deadband. It can be adjusted on the LID from a setting of 5 to 10, and the default setting is 6.0. Increasing either of these settings will cause the slide valve to respond slower than a lower setting.

The *PROPORTIONAL ECW GAIN* can be adjusted at the LID display for values of 1, 2, or 3, with a default setting of 2. Increase this setting to increase slide valve response to a change in entering cooler water temperature. The proportional bands and gain may be viewed/modified on the Equipment Service table, Service3 selection.

DEMAND LIMITING — The PIC will respond to the *ACTIVE DEMAND LIMIT* set point by limiting the closing of the slide valve. It will compare the set point to either *COMPRESSOR MOTOR LOAD* or *COMPRESSOR MOTOR CURRENT* (percentage), depending on how the control is configured for the *DEMAND LIMIT SOURCE* which is accessed on the SERVICE1 table. The default setting is current limiting.

MACHINE TIMERS — The PIC maintains 2 runtime clocks, known as *COMPRESSOR ONTIME* and *SERVICE ONTIME*. *COMPRESSOR ONTIME* indicates the total lifetime compressor run hours. This timer can register up to 500,000 hours before the clock turns back to zero. The *SERVICE ONTIME* is a resettable timer that can be used to indicate the hours since the last service visit or any other reason. The time can be changed through the LID to whatever value is desired. This timer can register up to 32,767 hours before it rolls over to zero.

The chiller also maintains a 15-minute start-to-start timer and a 1-minute stop-to-start timer (PSIO Software Version 13 and higher). A 3-minute stop-to-start timer is on PSIO Version 12 and lower. These timers limit how soon the machine can be started. See the Start-Up/Shutdown/Recycle Sequence section on page 37 for operational information.

OCCUPANCY SCHEDULE — This schedule determines when the chiller is either occupied or unoccupied. See Fig. 20 and 21.

PSIO Software Version 12 and Lower — Whenever the chiller is in the LOCAL mode, the machine will start when Occupancy Schedule 01 indicates occupied. When in CCN mode, Occupancy Schedule 02 is used. The machine will shut down when the schedule goes to UNOCCUPIED. The schedule can be set up to follow the building schedule or to be 100% OCCUPIED if the operator wishes the machine to start whenever the PIC is in LOCAL mode. The schedule also can be bypassed by forcing the Start/Stop command on the PIC status screen to start. The schedule also can be overridden to keep the unit in an OCCUPIED mode for up to 4 hours, on a one-time basis.

PSIO Software Version 13 and Higher — The Local Time Schedule is Schedule 01. The Ice Build Time Schedule is Schedule 02 and the CCN Default Time Schedule is Schedule 03. The CCN schedule number is defined on the Config table in the Equipment Configuration table on page 25. The schedule number can change to any value from 03 to 99. If this schedule number is changed on the Config table, the operator must use the Attach to Network Device table to upload the new number into the schedule screen. See Fig. 21.

Each schedule consists of from one to 8 occupied/unoccupied time periods, set by the operator. These time periods can be enabled to be in effect (or not in effect) on each day of the week and for holidays. The day begins with 0000 hours and ends with 2400 hours. The machine is in OCCUPIED mode unless an unoccupied time period is in effect.

Figure 22 shows a typical office building time schedule, with a 3-hour, off-peak cool down period from midnight to 3 a.m., following a weekend shutdown. Example: Holiday periods are unoccupied 24 hours per day. The building operates Monday through Friday, 7:00 a.m. to 6:00 p.m., with a Saturday schedule of 6:00 a.m. to 1:00 p.m., and includes the Monday midnight to 3:00 a.m. weekend cool-down schedule.

NOTE: This schedule is for illustration only and is not intended to be a recommended schedule for chiller operation.

Safety Controls — The PIC monitors all safety control inputs, and, if required, shuts down the machine, or limits the slide valve to protect it from possible damage from any of the following conditions:

- high motor winding temperature
- high discharge temperature
- low discharge superheat temperature (Frame 1 and 2 machines)
- low oil pressure
- high oil filter pressure drop
- low oil level
- low cooler refrigerant temperature
- condenser high pressure
- inadequate water/brine cooler and condenser flow
- high, low, or loss of voltage
- excessive motor acceleration time
- excessive starter transition time
- lack of motor current signal
- excessive motor amps
- motor power supply phase reversal
- temperature sensor and transducer faults

Starter faults or optional protective devices within the starter can shut down the machine. These devices are dependent on what has been purchased as options.

⚠ CAUTION

If compressor motor overload occurs, check the motor for grounded or open phases before attempting a restart.

If the controller initiates a safety shutdown, it displays the fault on the LID display with a primary and a secondary message. It also energizes an alarm relay in the starter and blinks the alarm light on the control center. The alarm is stored in memory and can be viewed in the PIC alarm table along with a message for troubleshooting.

To give more specific operating condition warning, the operator also can define alert limits on various monitored inputs. Safety contact and alert limits are defined in Table 4. Alarm and alert messages are listed in the Troubleshooting Guide section, page 68.

SHUNT TRIP — The shunt trip function of the PIC is a safety trip. The shunt trip is wired from an output on the SMM to the motor circuit breaker. If the PIC tries to shutdown the compressor through normal shutdown procedure but is unsuccessful for 30 seconds, the shunt trip output is energized and causes the circuit breaker to trip off. If ground fault protection has been applied to the starter, the ground fault trip will also energize the shunt trip to trip the circuit breaker.

Table 3 — LID Screens

IMPORTANT: The following notes apply to all Table 3 examples:

1. Only 12 lines of information will appear on the LID screen at any given time. Press NEXT or PREVIOUS to highlight a point, or to view points below or above the current screen.
2. The LID may be configured in English or Metric units, as required, through the LID configuration screen.
3. Data appearing in the ''Reference Points Names'' column is used for CCN operations only.
4. All options associated with ICE BUILD, LEAD/LAG, CCN OCCUPANCY CONFIGURATION, and SOFT STOPPING are only available in PSIO Software Version 13 and higher.
5. All values shall be variables available for read operation from a CCN Network. Descriptions designated (*) shall support write operations for BEST programming language, data transfer, and overriding.

EXAMPLE 1 — STATUS01 DISPLAY SCREEN

To access this display from the **LID default** screen:

1. Press **MENU** .
2. Press **STATUS** (**STATUS01** will be highlighted).
3. Press **SELECT** .

DESCRIPTION	RANGE	UNITS	REFERENCE POINT NAME
Control Mode	Reset, Off, Local, CCN		MODE
Run Status	Timeout, Recycle, Startup, Ramping, Running, Demand, Override, Shutdown, Abnormal, Pumpdown		STATUS
Occupied ?	No/Yes		OCC
Alarm State	NORMAL/ALARM		ALM
***Chiller Start/Stop**	STOP/START		CHIL__S__S
Base Demand Limit	40-100	%	DLM
***Active Demand Limit**	40-100	%	DEM__LIM
Compressor Motor Load	0-999	%	CA__L
Current	0-999	%	CA__P
Amps	0-999	AMPS	CA__A
***Manual Slide Valve Count**	−20-20		SV__MAN
Actual Slide Valve State	Increase, Hold, Decrease		SV__ACT
Water/Brine: Setpoint	20-120 (−6.7-48.9)	DEG F (DEG C)	SP
***Control Point**	20-120 (−6.7-48.9)	DEG F (DEG C)	LCW__STPT
Entering Chilled Water	−40-245 (−40-118)	DEG F (DEG C)	ECW
Leaving Chilled Water	−40-245 (−40-118)	DEG F (DEG C)	LCW
Entering Condenser Water	−40-245 (−40-118)	DEG F (DEG C)	ECDW
Leaving Condenser Water	−40-245 (−40-118)	DEG F (DEG C)	LCDW
Evaporator Refrig Temp	−40-245 (−40-118)	DEG F (DEG C)	ERT
***Evaporator Pressure**	6.7-420 (−46-2896)	PSI (kPa)	ERP
Condenser Refrig Temp	−40-245 (−40-118)	DEG F (DEG C)	CRT
***Condenser Pressure**	6.7-420 (−46-2896)	PSI (kPa)	CRP
Discharge Temperature	−40-245 (−40-118)	DEG F (DEG C)	CMPD
Rotor Inlet Temp	−40-245 (−40-118)	DEG F (DEG C)	RTRIN
Motor Winding Temp	−40-245 (−40-118)	DEG F (DEG C)	MTRW
Oil Sump Temperature	−40-245 (−40-118)	DEG F (DEG C)	OILT
***Oil Pressure Transducer**	6.7-420 (−46-2896)	PSI (kPa)	OILP
Oil Pressure	6.7-420 (−46-2896)	PSID (kPad)	OILPD
Line Voltage: Percent	0-999	%	V__P
Actual	0-9999	VOLTS	V__A
***Remote Contacts Input**	OFF/ON		REMCON
Total Compressor Starts	0-65535		c__starts
Starts in 12 Hours	0-8		STARTS
Compressor Ontime	0-500000	HOURS	c__hrs
***Service Ontime**	0-32767	HOURS	s__hrs
***Compressor Motor kW**	0-9999	kW	CKW__A

EXAMPLE 2 — STATUS02 DISPLAY SCREEN

To access this display from the **LID default** screen:

1. Press **MENU** .
2. Press **STATUS** .
3. Scroll down to highlight **STATUS02**.
4. Press **SELECT** .

DESCRIPTION	POINT TYPE		UNITS	REFERENCE POINT NAME
	Input	Output		
Slide Valve Increase		X	OFF/ON	SV__INC
Slide Valve Decrease		X	OFF/ON	SV__DEC
Hot Gas Bypass Relay		X	OFF/ON	HGBR
***Chilled Water Pump**		X	OFF/ON	CHWP
Chilled Water Flow	X		NO/YES	EVFL
***Condenser Water Pump**		X	OFF/ON	CDP
Condenser Water Flow	X		NO/YES	CDFL
Compressor Start Relay		X	OFF/ON	CMPR
Compressor Start Contact	X		OPEN/CLOSED	1CR__AUX
Compressor Run Contact	X		OPEN/CLOSED	RUN__AUX
Starter Fault Contact	X		OPEN/CLOSED	STR__FLT
Pressure Trip Contact	X		OPEN/CLOSED	PRS__TRIP
Single Cycle Dropout	X		NORMAL/ALARM	V1__CYCLE
Variable Inlet Relay		X	OFF/ON	VIR
Oil Heater Relay		X	OFF/ON	OILH
Oil Safety Sensor	X		OPEN/CLOSED	OILSS
***Tower Fan Relay**		X	OFF/ON	TFR
Compr Shunt Trip Relay		X	OFF/ON	TRIPR
Alarm Relay		X	NORMAL/ALARM	ALM
Spare Prot Limit Input	X		NORMAL/ALARM	SPR__PL

EXAMPLE 3 — STATUS03 DISPLAY SCREEN

To access this display from the **LID default** screen:

1. Press **MENU** .
2. Press **STATUS** .
3. Scroll down to highlight **STATUS03**.
4. Press **SELECT** .

DESCRIPTION	RANGE	UNITS	REFERENCE POINT NAME (ALARM HISTORY)
OPTIONS BOARD 1			
***Demand Limit 4-20 mA**	4-20	MA	DEM__OPT
***Temp Reset 4-20 mA**	4-20	MA	RES__OPT
***Common CHWS Sensor**	−40-245 (−40-118)	DEG F (DEG C)	CHWS
***Common CHWR Sensor**	−40-245 (−40-118)	DEG F (DEG C)	CHWR
***Remote Reset Sensor**	−40-245 (−40-118)	DEG F (DEG C)	R__RESET
***Temp Sensor — Spare 1**	−40-245 (−40-118)	DEG F (DEG C)	SPARE1
***Temp Sensor — Spare 2**	−40-245 (−40-118)	DEG F (DEG C)	SPARE2
***Temp Sensor — Spare 3**	−40-245 (−40-118)	DEG F (DEG C)	SPARE3
OPTIONS BOARD 2			
***4-20 mA — Spare 1**	4-20	MA	SPARE1__M
***4-20 mA — Spare 2**	4-20	MA	SPARE2__M
***Temp Sensor — Spare 4**	−40-245 (−40-118)	DEG F (DEG C)	SPARE4
***Temp Sensor — Spare 5**	−40-245 (−40-118)	DEG F (DEG C)	SPARE5
***Temp Sensor — Spare 6**	−40-245 (−40-118)	DEG F (DEG C)	SPARE6
***Temp Sensor — Spare 7**	−40-245 (−40-118)	DEG F (DEG C)	SPARE7
***Temp Sensor — Spare 8**	−40-245 (−40-118)	DEG F (DEG C)	SPARE8
***Temp Sensor — Spare 9**	−40-245 (−40-118)	DEG F (DEG C)	SPARE9

EXAMPLE 4 — SETPOINT DISPLAY SCREEN

To access this display from the **LID default** screen:

1. Press **MENU** .
2. Press **SETPOINT** .

DESCRIPTION	CONFIGURABLE RANGE	UNITS	REFERENCE POINT NAME	DEFAULT VALUE
Base Demand Limit	40-100	%	DLM	100
LCW Setpoint	15-120 (−9.44-48.9)	DEG F (DEG C)	sp LCW__SP	50.0 (10.0)
ECW Setpoint	20-120 (−6.7-15.6)	DEG F (DEG C)	ECW__SP	60.0 (15.6)
Ice Build Setpoint	20-60 (−6.7-15.6)	DEG F (DEG C)	ice__SP	40.0 (4.4)

EXAMPLE 5 — CONFIGURATION (CONFIG) DISPLAY SCREEN

To access this display from the **LID default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT CONFIGURATION**.
4. Press **SELECT** .
5. Scroll down to highlight **CONFIG**.
6. Press **SELECT** .

DESCRIPTION	CONFIGURABLE RANGE	UNITS	REFERENCE POINT NAME	DEFAULT VALUE
RESET TYPE 1				
Degrees Reset at 20 mA	−30-30 (−17-17)	DEG F (DEG C)	deg__20mA	10Δ)(6Δ))
RESET TYPE 2				
Remote Temp (No Reset)	−40-245 (−40-118)	DEG F (DEG C)	res__rt1	85 (29)
Remote Temp (Full Reset)	−40-245 (−40-118)	DEG F (DEG C)	res__rt2	65 (18)
Degrees Reset	−30-30 (−17-17)	DEG F (DEG C)	deg__rt	10Δ (6Δ)
RESET TYPE 3				
CHW Delta T (No Reset)	0-15 (0-8)	DEG F (DEG C)	restd__1	10Δ (6Δ)
CHW Delta T (Full Reset)	0-15 (0-8)	DEG F (DEG C)	restd__2	0Δ (0Δ)
Degrees Reset	−30-30 (−17-17)	DEG F (DEG C)	deg__chw	5Δ (3Δ)
Select/Enable Reset Type	0-3		res__sel	0
ECW Control Option	0/1	DSABLE/ENABLE	ecw__opt	0
Demand Limit At 20 mA	40-100	%	dem__20mA	40
20mA Demand Limit Option	0/1	DS/ENABLE	dem__sel	0
Auto Restart Option	0/1	DS/ENABLE	astart	0
Remote Contacts Option	0/1	DS/ENABLE	r__contact	0
Temp Pulldown Deg/Min	2-10		tmp__ramp	3
Load Pulldown %/Min	5-20		kw__ramp	10
Select Ramp Type:	0/1		ramp__opt	1
Temp = 0, Load = 1				
Loadshed Group Number	0-99		ldsgrp	0
Loadshed Demand Delta	0-60	%	ldsdelta	20
Maximum Loadshed Time	0-120	MIN	maxldstm	60
CCN Occupancy Config:				
Schedule Number	3-99		OCCpcxxe	3
Broadcast Option	0/1	DS/ENABLE	OCCbrcst	0
Ice Build Option	0/1	DS/ENABLE	ibopt	DISABLE
Ice Build Termination	0-2		ibterm	0
0=Temp, 1=Contacts, 2=Both				
Ice Build Recycle Option	0/1	DS/ENABLE	ibrecyc	DISABLE

NOTE: Δ = delta degrees

Table 3 — LID Screens (cont)

EXAMPLE 6 — LEAD/LAG CONFIGURATION DISPLAY SCREEN

To access this display from the **LID default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT CONFIGURATION.**
4. Press **SELECT** .
5. Scroll down to highlight **LEAD/LAG**.
6. Press **SELECT** .

LEAD/LAG CONFIGURATION SCREEN

DESCRIPTION	RANGE	UNITS	REFERENCE POINT NAME	DEFAULT VALUE
LEAD/LAG SELECT DISABLE=0, LEAD=1 LAG=2, STANDBY=3	0-3		leadlag	0-
Load Balance Option	0/1	DSABLE/ENABLE	loadbal	DSABLE
Common Sensor Option	0/1	DSABLE/ENABLE	commsens	DSABLE
LAG Percent Capacity	25-75	%	lag__per	50
LAG Address	1-236		lag__add	92
LAG START Timer	2-60	MIN	lagstart	10
LAG STOP Timer	2-60	MIN	lagstop	10
PRESTART FAULT Timer	0-30	MIN	preflt	5
STANDBY Chiller Option	0/1	DSABLE/ENABLE	stndopt	DSABLE
STANDBY Percent Capacity	25-75	%	stnd__per	50
STANDBY Address	1-236		stnd__add	93

NOTE: This screen is only selectable/readable on PSIO Software Version 13 and higher.

EXAMPLE 7 — SERVICE1 DISPLAY SCREEN

To access this display from the **LID default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT SERVICE**.
4. Press **SELECT** .
5. Scroll down to highlight **SERVICE1**.
6. Press **SELECT** .

DESCRIPTION	CONFIGURABLE RANGE	UNITS	REFERENCE POINT NAME	DEFAULT VALUE
Motor Temp Override	150-200 (66-93)	DEG F (DEG C)	mt__over	200 (93)
Cond Press Override	150-250 (1034-1724)	PSI (kPa)	cp__over	230 (1586)
Refrig Override Delta T	2-5 (1-3)	DEG F (DEG C)	ref__over	3Δ(1.7Δ)
Chilled Medium	WATER/BRINE		medium	WATER
Brine Refrig Trippoint	8-40 (−13.3-4)	DEG F (DEG C)	br__trip	33 (1)
Compr Discharge Alert	170-200 F (77-93 C)	DEG F (DEG C)	cd__alert	200 (93)
Water Flow Verify Time	0.5-5	MIN	wflow__t	5
Oil Filter Press Alert	15-30 (103-207)	PSID (kPad)	oil__alrt	30 (207)
Water/Brine Deadband	0.5-2.0 (0.3-1.1)	DEG F (DEG C)	cw__db	1.0 (0.6)
Recycle Restart Delta T	2.0-10.0 (1.1-5.6)	DEG F (DEG C)	rcyc__dt	5 (2.8)
Hot Gas Bypass Option	0/1	DSABLE/ENABLE	hgbp	0
HGBP Delta T1	0.5-15 (0.3-5.6)	DEG F (DEG C)	hgb__dt1	2.5Δ (1.4Δ)
HGBP Delta P1 Min. Load Points (T1/P1)	50-200 (345-1379) [30-170 (207-1172)]		hgb__dp1	100 (690) [55 (379)]
HGBP Delta T2	0.5-15 (0.3-5.6)	DEG F (DEG C)	hgb__dt2	10Δ (1Δ)
HGBP Delta P2 Full Load Points (T2/P2)	50-200 (345-1379) [30-170 (207-1172)]	PSID (kPad)	hgb__dp2	200 (1379) [125 (862)]
HGBP Deadband	1-3 (0.6-1.7)	DEG F (DEG C)	hgb__dp	1 (0.6)
Demand Limit Source Select: Amps=0, Load=1	0/1	PSID (kPad)	dem__src	0
Amps Correction Factor	1-8		corfact	3
Motor Rated Load Amps	1-9999	AMPS	a__fs	200
Motor Rated Line Voltage	1-9999	VOLTS	v__fs	460
Meter Rated Line kW	1-9999	kW	kw__fs	600
Line Frequency Select: 0=60 Hz, 1=50 Hz	0/1	HZ	freq	0
Compr Starter Type	0/1	REDUCE/FULL	starter	REDUCE
Variable Inlet Option	0/1	DSABLE/ENABLE	vi__opt	DSABLE
Economizer Installed	0/1	NO/YES	economiz	NO
Condenser Freeze Point	−20-35 (−28.9-1.7)	DEG F (DEG C)	cdfreeze	34 (1.1)
Soft Stop Amps Threshold	40-100	%	softstop	100

NOTES:
1. Δ = delta degrees.
2. Values in [ ] indicate HFC-134a values.

EXAMPLE 8 — SERVICE2 DISPLAY SCREEN

To access this display from the **LID default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT SERVICE**.
4. Press **SELECT** .
5. Scroll down to highlight **SERVICE2**.
6. Press **SELECT** .

DESCRIPTION	CONFIGURABLE RANGE	UNITS	REFERENCE POINT NAME	DEFAULT VALUE
OPTIONS BOARD 1				
20 mA POWER CONFIGURATION External = 0, Internal = 1				
RESET 20 mA Power Source	0/1	DISABLE/ENABLE	res__20 mA	0
DEMAND 20 mA Power Source	0/1	DISABLE/ENABLE	dem__20 mA	0
SPARE ALERT ENABLE Disable = 0, Low = 1, High = 2 Temp = Alert Threshold				
CHWS Temp Enable	0-2		chws__en	0
CHWS Temp Alert	−40-245 (−40-118)	DEG F (DEG C)	chws__al	245 (118)
CHWR Temp Enable	0-2		chwr__en	0
CHWR Temp Alert	−40-245 (−40-118)	DEG F (DEG C)	chwr__al	245 (118)
Reset Temp Enable	0-2		rres__en	0
Reset Temp Alert	−40-245 (−40-118)	DEG F (DEG C)	rres__al	245 (118)
Spare Temp 1 Enable	0-2		spr1__en	0
Spare Temp 1 Alert	−40-245 (−40-118)	DEG F (DEG C)	spr1__al	245 (118)
Spare Temp 2 Enable	0-2		spr2__en	0
Spare Temp 2 Alert	−40-245 (−40-118)	DEG F (DEG C)	spr2__al	245 (118)
Spare Temp 3 Enable	0-2		spr3__en	0
Spare Temp 3 Alert	−40-245 (−40-118)	DEG F (DEG C)	spr3__al	245 (118)
OPTIONS BOARD 2				
20 mA POWER CONFIGURATION External = 0, Internal = 1				
SPARE1 20 mA Power Source	0/1	DISABLE/ENABLE	sp1__20 mA	0
SPARE2 20 mA Power Source	0/1	DISABLE/ENABLE	sp2__20 mA	0
SPARE ALERT ENABLE Disable = 0, Low = 1, High = 2 Temp = Alert Threshold				
Spare Temp 4 Enable	0-2		spr4__en	0
Spare Temp 4 Alert	−40-245 (−40-118)	DEG F (DEG C)	spr4__al	245 (118)
Spare Temp 5 Enable	0-2		spr5__en	0
Spare Temp 5 Alert	−40-245 (−40-118)	DEG F (DEG C)	spr5__al	245 (118)
Spare Temp 6 Enable	0-2		spr6__en	0
Spare Temp 6 Alert	−40-245 (−40-118)	DEG F (DEG C)	spr6__al	245 (118)
Spare Temp 7 Enable	0-2		spr7__en	0
Spare Temp 7 Alert	−40-245 (−40-118)	DEG F (DEG C)	spr7__al	245 (118)
Spare Temp 8 Enable	0-2		spr8__en	0
Spare Temp 8 Alert	−40-245 (−40-118)	DEG F (DEG C)	spr8__al	245 (118)
Spare Temp 9 Enable	0-2		spr9__en	0
Spare Temp 9 Alert	−40-245 (−40-118)	DEG F (DEG C)	spr9__al	245 (118)

NOTE: This screen provides the means to generate alert messages based on exceeding the ‘‘Temp Alert’’ threshold for each point listed. If the ‘‘Enable’’ is set to 1, a value above the ‘‘Temp Alert’’ threshold shall generate an alert message. If the ‘‘Enable’’ is set to 2, a value below the ‘‘Temp Alert’’ threshold shall generate an alert message. If the ‘‘Enable’’ is set to 0, alert generation is disabled.

EXAMPLE 9 — SERVICE3 DISPLAY SCREEN

To access this display from the **LID default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT SERVICE**.
4. Press **SELECT** .
5. Scroll down to highlight **SERVICE3**.

DESCRIPTION	CONFIGURABLE RANGE	REFERENCE POINT NAME	DEFAULT VALUE
Proportional Inc Band	5-10	gv__inc	6.5
Proportional Dec Band	5-10	gv__de	6.0
Proportional ECW Gain	1-3	gv__ecw	2.0

EXAMPLE 10 — MAINTENANCE (MAINT01) DISPLAY SCREEN

To access this display from the **LID default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **CONTROL ALGORITHM STATUS**.
4. Press **SELECT** .
5. Scroll down to highlight **MAINT01**.

DESCRIPTION	CONFIGURABLE RANGE	UNITS	REFERENCE POINT NAME	DEFAULT VALUE
CAPACITY CONTROL				
Control Point	0-120 (−17.8-48.9)	DEG F (DEG C)	ctript	
Leaving Chilled Water	−40-245 (−40-118)	DEG F (DEG C)	LCW	
Entering Chilled Water	−40-245 (−40-118)	DEG F (DEG C)	ECW	
Control Point Error	−99-99 (−55-55)	DEG F (DEG C)	cperr	
ECW Delta T	−99-99 (−55-55)	DEG F (DEG C)	ecwdt	
ECW Reset	−99-99 (−55-55)	DEG F (DEG C)	ecwres	
LCW Reset	−99-99 (−55-55)	DEG F (DEG C)	lcwres	
Total Error + Resets	−99-99 (−55-55)	DEG F (DEG C)	error	
Manual Slide Valve Count	−20-20		svt	
Actual Slide Valve State	Increase, Hold, Decrease		SV___ACT	
Proportional Inc Band	5-10		sv___inc	6.5
Proportional Dec Band	5-10		sv__dec	6.0
Proportional ECW Gain	1-3		sv__ecw	2.0
Water/Brine Deadband	0.5-2 (0.3-1.1)	DEG F (DEG C)	cwdb	1.0 (.5)

NOTE: Overriding shall not be supported on this maintenance screen. Active overriding shall show the associated point in alert (!). Only values with capital letter reference point names shall be variables available for read operation.

Table 3 — LID Screens (cont)

EXAMPLE 11 — MAINTENANCE (MAINT02) DISPLAY SCREEN

To access this display from the **LID default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **CONTROL ALGORITHM STATUS**.
4. Press **SELECT** .
5. Scroll down to highlight **MAINT02**.
6. Press **SELECT** .

DESCRIPTION	CONFIGURABLE RANGE	UNITS	REFERENCE POINT NAME	DEFAULT VALUE
OVERRIDE/ALERT STATUS				
MOTOR WINDING TEMP	−40-245 (−40-118)	DEG F (DEG C)	MTRW	
Override Threshold	150-200 (66-93)	DEG F (DEG C)	mt__over	200 (93)
CONDENSER PRESSURE	0-420 (0-2896)	PSI (kPa)	CRP	
Override Threshold	150-250 (1034-1724)	PSI (kPa)	cp__over	230 (1586)
EVAPORATOR REFRIG TEMP	−40-245 (−40-118)	DEG F (DEG C)	ERT	
Override Threshold	2-45 (1-7.2)	DEG F (DEG C)	rt__over	35 (1.7)
DISCHARGE TEMPERATURE	−40-245 (−40-118)	DEG F (DEG C)	CMPD	
Alert Threshold	170-200 (76.7-93.3)	DEG F (DEG C)	cd__alert	200 (93.3)
OIL FILTER PRESSURE DROP	0-120 (0-827)	PSID (kPad)	oil__fltr	
Alert Threshold	15-90 (103-621)	PSID (kPad)	oil__alrt	30 (207)

NOTES:
1. Overriding shall not be supported on this maintenance screen. Active overrides shall show the associated point in alert (!). Only values with capital letter reference point names shall be variables available for read operation.
2. Values in [ ] indicate HFC-134a values.

EXAMPLE 12 — MAINTENANCE (MAINT03) DISPLAY SCREEN

To access this display from the **LID default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **CONTROL ALGORITHM STATUS**.
4. Press **SELECT** .
5. Scroll down to highlight **MAINT03**.
6. Press **SELECT** .

DESCRIPTION	STATUS	UNITS	REFERENCE POINT NAME
Hot Gas Bypass ACTIVE ?	NO/YES		
Active Delta P	0-200 (0-1379)	PSI (kPa)	dp__a
Active Delta T	0-200 (0-111)	DEG F (DEG C)	dt__a
Calculated Delta T	0-200 (0-111)	DEG F (DEG C)	dt__c

NOTE: Overriding shall not be supported on this maintenance screen. Active overrides shall show the associated point in alert (*). Only values with capital letter reference point names shall be variables available for read operation.

EXAMPLE 13 — MAINTENANCE (MAINT04) DISPLAY SCREEN

To access this display from the **LID default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **CONTROL ALGORITHM STATUS**.
4. Press **SELECT** .
5. Scroll down to highlight **MAINT04.**.
6. Press **SELECT** .

DESCRIPTION	STATUS	UNITS	REFERENCE POINT NAME
LEAD/LAG: Configuration	DISABLE,LEAD,LAG,STANDBY		leadlag
Current Mode	DISABLE,LEAD,LAG,STANDBY		llmode
Load Balance Option	DISABLE/ENABLE		loadbal
LAG Start Time	0-99	MIN	lagstart
LAG Stop Time	0-99	MIN	lagstop
Prestart Fault Time	0-30	MIN	preflt
Pulldown: Delta T/Min	x.xx	Δ DEG	pull__dt
Satisfied?	0/1	NO/YES	pull__sat
LEAD CHILLER in Control	0/1	NO/YES	leadctrl
LAG CHILLER: Mode	Reset,Off,Local,CCN		lagmode
Run Status	Timeout,Recycle,Startup,Ramping,Running Demand,Override,Shutdown,Abnormal,Pumpdown		lagstat
Start/Stop	Stop,Start,Retain		lag__s__s
Recovery Start Request	No/Yes		lag__rec
STANDBY CHILLER: Mode	Reset,Off,Local,CCN		stdmode
Run Status	Timeout,Recycle,Startup, Ramping,Running Demand,Override,Shutdown,Abnormal,Pumpdown		stdstat
Start/Stop	Stop,Start,Retain		std__s__s
Recovery Start Request	No/Yes		std__rec

NOTES:
1. Overriding shall not be supported on this maintenance screen.
2. Δ =delta degrees.

Ramp Loading Control — The ramp loading control slows down the rate at which the compressor loads up. This control can prevent the compressor from loading up during the short period of time when the machine is started, and the chilled water loop has to be brought down to normal design conditions. This helps reduce electrical demand charges by slowly bringing the chilled water to control point. However, the total power draw during this period remains almost unchanged.

There are 2 methods of ramp loading with the PIC. Ramp loading can be based on chilled water temperature or on motor load.

1. Temperature ramp loading limits the rate at which either leaving chilled water or entering chilled water temperature decreases by an operator-configured rate.
2. Motor load ramp loading limits the rate at which the compressor motor current or compressor motor load increases by an operator-configured rate.

The *TEMP (Temperature) PULLDOWN*, *LOAD PULL DOWN*, and *SELECT RAMP TYPE* may be viewed/modified on the LID Equipment Configuration table Config selection (see Table 3). Motor load is the default type.

Capacity Overrides (Table 5) — These can prevent some safety shutdowns caused by exceeding motor amperage limit, refrigerant low temperature safety limit, motor high temperature safety limit, and condenser high pressure limit. In all cases there are 2 stages of compressor slide valve control.

1. The slide valve is held from closing further, and the status line on the LID indicates the reason for the override.
2. The slide valve is opened until condition decreases below the first step set point, and then the valve is released to normal capacity control.

Whenever the motor current demand limit set point is reached, it activates a capacity override, again with a two-step process. Exceeding 110% of the rated load amps for more than 10 seconds will initiate a safety shutdown.

Oil Sump Temperature Control (Frame 1 and 2 Machines Only) — The oil sump temperature control is regulated by the PIC using the oil heater relay when the machine is shut down. The oil heater relay is energized whenever the chiller compressor is off, and the oil sump temperature is less than 140 F (60 C) or sump temperature is less than the cooler refrigerant temperature plus 60 F (33 C). The heater is then turned off when the oil sump temperature is:

1. More than 160 F (71 C).
2. The sump temperature is more than 145 F (62.8 C) and more than the cooler refrigerant temperature plus 65 F (18.3 C). (The heater is always off during start-up or when the compressor is running.)

NOTE: Frame 4 units do not use an oil heater.

⚠ WARNING

All oil filter isolation valves should always be left open, except when changing the oil or oil filter as defined in the Changing Oil and Oil Filter section, page 64.

Remote Start/Stop Controls — A remote device, such as a timeclock, which uses a set of contacts, may be used to start and stop the machine. However, the device should not be programmed to start and stop the machine in excess of 2 or 3 times every 12 hours. If more than 8 starts in 12 hours occur, then an ''Excessive Recycle Starts'' alert is displayed, preventing the machine from starting. The operator must reset the alert at the LID in order to override the starts counter and start the machine. If Automatic Restart After a Power Failure is not activated when a power failure occurs, and the remote contact is closed, the machine will indicate an alarm because of the loss of voltage.

The contacts for Remote Start are wired into the starter at terminal strip TB5, as well as terminals 8A and 8B. See the certified drawings for further details on contact ratings. The contacts must be dry (no power).

Spare Safety Inputs — Normally closed digital inputs for additional field-supplied safeties may be wired to the spare protective limits input channel in place of the factory-installed jumper. (Wire multiple inputs in series.) The opening of any contact will result in a safety shutdown and LID display showing ''SPARE SAFETY DEVICE.''

Analog temperature sensors may also be added to the options modules, if installed. These may be programmed to cause an alert on the CCN network, but will not shut the machine down.

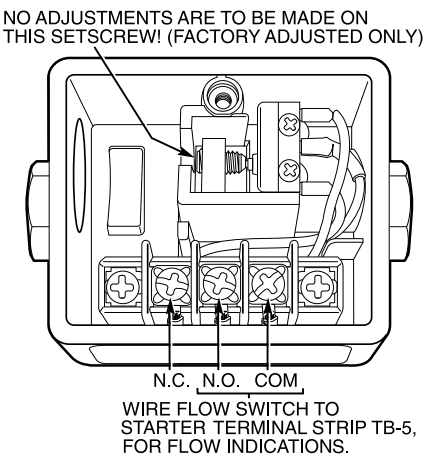
SPARE ALARM CONTACTS — Two spare sets of alarm contacts and provided within the starter. The contact ratings are provided in the certified drawings. The contacts are located on terminal strip TB6, as well as terminals 5A, 5B, 5C, and 5D.

Condenser Pump Control — The machine will monitor the *CONDENSER PRESSURE* and may turn on this pump if the pressure becomes too high whenever the compressor is shut down. *CONDENSER PRESSURE OVERRIDE* is used to determine this pressure point. This value is found on the Equipment Service1 LID table and has a default value (Table 3). If the *CONDENSER PRESSURE* is greater than or equal to the *CONDENSER PRESSURE OVERRIDE*, and the *ENTERING CONDENSER WATER TEMP (Temperature)* is less than 115 F (46 C), then the condenser pump will energize to try to decrease the pressure. The pump will turn off when the condenser pressure is less than the pressure override less 5 psi (34 kPa) [3.5 psi (24 kPa)], or the *CONDENSER REFRIG (Refrigerant) TEMP* is within 3° F (2° C) of the *ENTERING CONDENSER WATER* temperature.

Table 4 — Protective Limits and Control Settings

MONITORED PARAMETER	LIMIT	APPLICABLE COMMENTS
TEMPERATURE SENSORS OUT OF RANGE	−40 to 245 F (−40 to 118.3 C)	Must be outside range for 3 seconds
PRESSURE TRANSDUCERS OUT OF RANGE	0.06 to 0.98 Voltage Ratio	Must be outside range for 3 seconds. Ratio = Input Voltage ÷ Voltage Reference
COMPRESSOR DISCHARGE TEMPERATURE	>200 F (93 C)	Preset; alert setting configurable
LOW DISCHARGE SUPERHEAT	Oil sump temp −condenser refrigerant temp is less than 20 F (11.1 C). Only applicable to Frame 1 and 2 machines.	Preset monitored 30 minutes after start-up completion must be outside range for 10 consecutive minutes.
CONDENSER FREEZE PROTECTION	Energizes condenser pump relay if condenser refrigerant temperature or condenser entering water temperature is below the configured condenser freeze point temperature. Deenergizes when the temperature is 5 F (3 C) above condenser freeze point temperature	CONDENSER FREEZE POINT configured in Service01 table with a default setting of 34 F (1 C).
MOTOR WINDING TEMPERATURE	>220 F (104.4 C)	Preset; alert setting configurable
PHASE REVERSAL (MOTOR ROTATION)	<Start-up condenser pressure - 5 psi (34.5 kPa)	Preset; must be outside range for 3 seconds monitored after compressor motor current > 10%
EVAPORATOR REFRIGERANT TEMPERATURE	<33 F (0.6 C) for water chilling	Preset; configure chilled medium for water (Service1 table)
	<1° F below Design Refrigerant Temperature (set point adjustable from 8 to 40 F [−13 to 4 C] for brine chilling)	Configure chilled medium for brine (Service1 screen). Adjust brine refrigerant trippoint for proper cutout
TRANSDUCER VOLTAGE	<4.5 vdc, > 5.5 vdc	Preset
CONDENSER PRESSURE	>260 psig (1793 kPa)	Preset; alert setting configurable
OIL PRESSURE: **— Dirty Oil Filter**	Oil pressure transducer less than condenser pressure — oil filer pressure alert starting 40 seconds after motor current > 10% and oil pressure verified	Must be outside range for 3 seconds; oil pressure alert setting configurable from 15 - 30 psi (103.4 - 206.8 kPa) on Service1 table
	Oil pressure transducer less than condenser pressure — 110 psi (758 kPa) starting 40 seconds after motor current > 10% and oil pressure verified	Must be outside range for 3 seconds
— Low Oil Pressure	<Required oil pressure + 5 psi (34.5 kPa) starting 60 seconds after motor current > 10%	Ramp-up rate. See Table 1.
	<Required oil pressure starting 120 seconds after motor current > 10%	Minimum required oil pressure based on system pressure ratio is between 20 psi (137.9 kPa) [7 psi (48 kPa)] and 40 psi (275.8 kPa)
OIL LEVEL	Discrete	Preset; must be outside range for 15 seconds
LINE VOLTAGE — HIGH	>110% for one minute	Preset
— LOW	<90% and >85% for one minute or ≤85% for 3 seconds	
— SINGLE-CYCLE	<50% for one cycle	
COMPRESSOR MOTOR LOAD	>110% for 10-30 seconds	Preset
	<10% with compressor running	
	>10% with compressor off	
STARTER ACCELERATION TIME (Determined by inrush current going below 100% compressor motor load)	>15 seconds	For machines with reduced voltage mechanical and solid state starters
	>5 seconds	For machines with full voltage starters (Configured on Service1 table)
STARTER TRANSITION	>30 seconds	For machines with reduced voltage starters and solid-state starters

Flow Switch (Field Supplied)
Operate water pumps with machine off. Manually reduce water flow and observe switch for proper cutout. Safety shutdown occurs when cutout time exceeds 3 seconds. Switches are required to be rated electronically at 24 vdc.


NO ADJUSTMENTS ARE TO BE MADE ON THIS SETSCREW! (FACTORY ADJUSTED ONLY)
N.C.
N.O.
COM
WIRE FLOW SWITCH TO STARTER TERMINAL STRIP TB-5, FOR FLOW INDICATIONS.

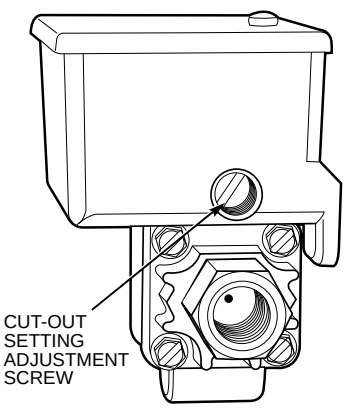


Table 5 — Capacity Overrides

OVERRIDE CAPACITY CONTROL	VIEW/MODIFY ON LID TABLE	FIRST STAGE SETPOINT		SECOND STAGE SET POINT	OVERRIDE TERMINATION
		Default Value	Configurable Range		
HIGH CONDENSER PRESSURE	EQUIPMENT SERVICE1	230 psi (1586 kPa)	150 to 250 psi (1034 to 1724 kPa)	≥Override Set point +5 psi (35 kPa)	<Override Set Point
HIGH MOTOR TEMPERATURE	EQUIPMENT SERVICE1	>200 F (93 C)	150 to 200 F (66 to 93 C)	>Override Set point + 10 F (6 C)	<Override Set Point
LOW REFRIGERANT TEMPERATURE (REFRIGERANT OVERRIDE AT TEMPERATURE)	EQUIPMENT SERVICE1	<2 F (1 C) Above Trippoint	2 to 5 F (1 to 3 C)	<Trippoint + (Override ΔT — 1 F [0.56 C])	>Trippiont + (Override ΔT + 2 F [1.2 C])
MANUAL SLIDE VALVE TARGET	CONTROL ALGORITHM MAINT01	Automatic	−20 to 20 Counts	Manual control cannot default active control	Release of Manual Control
MOTOR LOAD — ACTIVE DEMAND LIMIT	STATUS01	100%	40 to 100%	≥105% of Set Point	2% Lower Than Set Point

NOTE: [ ] indicates HFC-134a values.

Condenser Freeze Prevention — This control algorithm helps prevent condenser tube freeze up by energizing the condenser pump relay. If the pump is controlled by the PIC, starting the pump will help prevent the water in the condenser from freezing. Condenser freeze prevention can occur whenever the machine is not running except when it is actively in Pumpdown or in Pumpdown Lockout with the freeze prevention disabled (refer to Control Test table, Pumpdown/Terminate Lockout screens). See Fig. 21. When Pumpdown Lockout is initiated, if the CONDENSER REFRIG TEMP is less than 40 F (4.4 C), then condenser freeze prevention shall be disabled until termination of pumpdown lockout.

When the CONDENSER REFRIG TEMP is less than or equal to the CONDENSER FREEZE POINT or the ENTERING CONDENSER WATER temperature is less than or equal to the CONDENSER FREEZE POINT, then the CONDENSER WATER PUMP shall be energized until the CONDENSER REFRIG TEMP is greater then the CONDENSER FREEZE POINT plus 5° F (2.7° C). An alarm will be generated if the machine is in PUMPDOWN mode and the pump is energized. An alert will be generated if the machine is not in PUMPDOWN mode and the pump is energized.

Either of the above on requirements may independently result in the CONDENSER WATER PUMP being energized. However, both sets of off requirements must be met in order for the pump to be deenergized.

Tower-Fan Relay — The tower fan relay, located in the starter, is controlled by the PIC to energize and deenergize as the pressure differential between cooler and condenser vessels changes in order to prevent low condenser water temperature and to maximize machine efficiency. The tower-fan relay can only accomplish this if the relay has been added to the cooling tower temperature controller. The *TOWER FAN RELAY* is turned on whenever the *CONDENSER WATER PUMP* is running, flow is verified, and the difference between cooler and condenser pressure is more than 50 psi (433 kPa) or *ENTERING CONDENSER WATER* is greater than 85 F (29 C). The *TOWER FAN RELAY* is deenergized when the condenser pump is off, flow is lost, the evaporator refrigerant temperature is less than the override temperature, or the differential pressure is less than 45 psi (310 kPa) and *ENTERING CONDENSER WATER is less than 80 F (27 C).*

IMPORTANT: A field supplied water temperature control system should be installed. The system should maintain the leaving condenser water temperature at a temperature that is 18 F (10 C) above the leaving chilled water temperature.

⚠ CAUTION

The tower fan relay control is not a substitute for a jobsite condenser water temperature control. When used with a Water Temperature Control system, the tower fan relay control can be used to help prevent low condenser water temperatures.

Auto. Restart After Power Failure — This option may be enabled or disabled, and may be viewed/modified on the Equipment Configuration menu Config table. If enabled, the chiller will start up automatically after a single cycle dropout, low, high, or loss of voltage has occurred, and the power is within ±10% of normal. The start inhibit timers are ignored during this type of start-up.

Water/Brine Reset — Three types of chilled water or brine reset are available and can be viewed or modified on the Equipment Configuration menu Config table.

The default screen status message indicates when the chilled water reset is active. The CONTROL POINT, on the Status01 table, indicates the machine's reset temperature.

To activate a reset type, input all configuration information for that reset type in the Config table. Then input the reset type number in the DISABLE/ENABLE input line.

1. Reset Type 1 (Requires optional 8-input module) — Automatic chilled water temperature reset based on a 4 to 20 mA input signal. This type permits up to ±30° F (±16° C) of automatic reset to the chilled water or brine temperature set point, based on the input from a 4 to 20 mA signal. This signal is hardwired into the number one 8-input module.

   If the 4 to 20 mA signal is externally powered from the 8-input module, the signal is wired to terminals J1-5(+) and J1-6(−). If the signal is to be internally powered by the 8-input module (for example, when using variable resistance), the signal is wired to J1-7(+) and J1-6(−). The PIC must now be configured on the Service2 table to ensure that the appropriate power source is identified.
2. Reset Type 2 (Requires optional 8-input module) — Automatic chilled water temperature reset based on a remote temperature sensor input. This type permits ±30° F (±16° C) of automatic reset to the set point based on a temperature sensor wired to the number one 8-input module (see wiring diagrams or certified drawings).

   The temperature sensor must be wired to terminal J1-19 and J1-20.

   To configure Reset Type 2, enter the temperature of the remote sensor at the point where no temperature reset will occur. Next, enter the temperature at which the full amount of reset will occur. Then, enter the maximum amount of reset required to operate the machine. Reset Type 2 can now be activated.
3. Reset Type 3 — Automatic chilled water temperature reset based on cooler temperature difference. This type of reset will add ±30° F (±16° C) based on the temperature difference between entering and leaving chilled water temperature. This is the only type of reset available without the need of the number one 8-input module. No wiring is required for this type as it already uses the cooler water sensors.

   To configure Reset Type 3, enter the chilled water temperature difference (the difference between entering and leaving chilled water) at which no temperature reset occurs. This chilled water temperature difference is usually the full design load temperature difference. The difference in chilled water temperature at which the full amount of reset will occur is now entered on the next input line. Next, the amount of reset is entered. Reset Type 3 can now be activated.

Demand Limit Control, Option — (Requires Optional 8-Input Module) — The demand limit may be externally controlled with a 4 to 20 mA signal from an energy management system (EMS). The option is set up on the Config table. When enabled, the control is set for 100% demand with 4 mA and an operator configured minimum demand set point at 20 mA.

The Demand Reset input from an energy management system is hardwired into the number one, 8-input module. The signal may be internally powered by the module or externally powered. If the signal is externally powered, the signal is wired to terminals J1-1(+) and J1-2(−). If the signal is internally powered, the signal is wired to terminals J1-3(+) and J1-2(−).

Hot Gas Bypass (Optional) Algorithm (See Fig. 24 and 25) — If a hot gas bypass solenoid valve is present, and the hot gas bypass option on the SERVICE1 table is enabled, this operator configurable feature can determine if load conditions are too low for the compressor and then take corrective action.

The algorithm first determines if corrective action is necessary. This is done by checking two sets of operator configured data points, which are the MINIMUM and the MAXIMUM Load Points, (T1/P1;T2/P2). These points have default settings for each type of refrigerant, HCFC-22 or HFC-134a, as defined on the SERVICE1 table, and on Table 3. These settings and the algorithm logic are graphically displayed in Fig. 24 and 25. The two sets of load points on this graph (default settings are shown) describe a line which the algorithm uses to activate the hot gas bypass. Whenever the temperature difference between the entering and leaving chilled water is on the left side of the line on the graph (as defined by the MINIMUM and MAXIMUM Load Points), the algorithm will then energize the hot gas bypass valve to falsely load the machine and prevent displacement of oil. If the actual values are on the right side of the line, the algorithm takes no action.

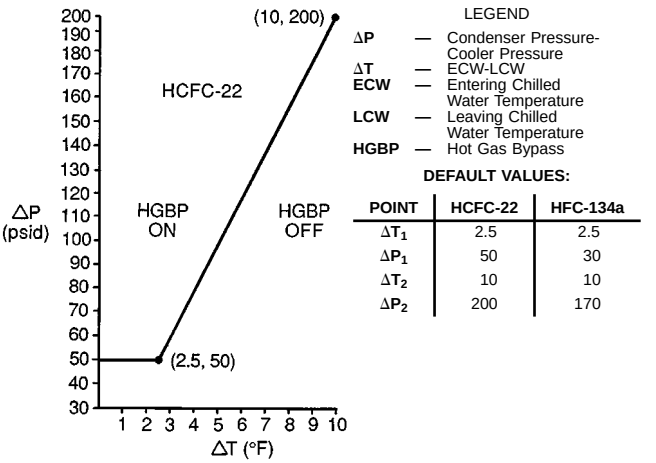


Fig. 24 — 23XL Hot Gas Bypass (English)

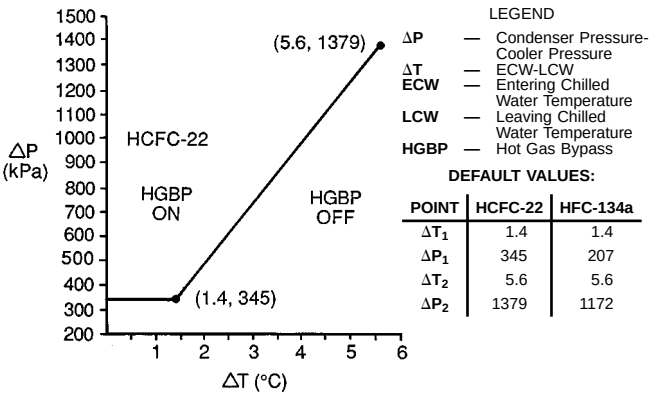


Fig. 25 — 23XL Hot Gas Bypass (SI)

Lead/Lag Control

IMPORTANT: Lead/lag control is only available on machines with PSIO Software Version 13 or higher.

Lead/lag is a control system process that automatically starts and stops a lag or second chiller in a 2 chiller water system. Refer to Fig. 20 and 21 for menu, table, and screen selection information. On machines that have PSIO software with Lead/Lag capability, it is possible to utilize the PIC controls to perform the lead/lag function on 2 machines. A third machine can be added to the lead/lag system as a standby chiller to start up in case the lead or lag chiller in the system has shut down during an alarm condition and additional cooling is required.

NOTE: Lead/lag configuration is viewed and edited under the LEAD/LAG in the Equipment Configuration table, located in the Service menu. See Table 3, Example 6. Lead/lag status during machine operation is viewed in the MAINT04 table in the Control Algorithm Status table. See Table 3, Example 12.

Lead/Lag System Requirements:
- all machines must have PSIO software capable of performing the lead/lag function
- water pumps MUST be energized from the PIC controls
- water flows should be constant
- CCN Time Schedules for all machines must be identical

Operation Features:
- 2 chiller lead/lag
- addition of a third chiller for backup
- manual rotation of lead chiller
- load balancing if configured
- staggered restart of the chillers after a power failure
- chillers may be piped in parallel or in series chilled water flow

COMMON POINT SENSOR INSTALLATION — Lead/lag operation does not require a common chilled water point sensor. Common point sensors can be added to the 8-input options module, if desired. Refer to the certified drawings for termination of sensor leads.

NOTE: If the common point sensor option is chosen on a chilled water system, both machines should have their own 8-input option module and common point sensor installed. Each machine will use its own common point sensor for control, when that machine is designated as the lead chiller. The PIC cannot read the value of common point sensors installed on other machines in the chilled water system.

When installing chillers in series, a common point sensor should be used. If a common point sensor is not used, the leaving chilled water sensor of the upstream chiller must be moved into the leaving chilled water pipe of the downstream chiller.

If return chilled water control is required on chillers piped in series, the common point return chilled water sensor should be installed. If this sensor is not installed, the return chilled water sensor of the downstream chiller must be relocated to the return chilled water pipe of the upstream machine.

To properly control the common supply point temperature sensor when chillers are piped in parallel, the water flow through the shutdown chillers must be isolated so that no water bypass around the operating chiller occurs. The common point sensor option must not be used if water bypass around the operating chiller is occurring.

MACHINE COMMUNICATION WIRING — Refer to the machine's Installation Instructions, Carrier Comfort Network Interface section on page 49 for information on machine communication wiring.

LEAD/LAG OPERATION — The PIC control provides the ability to operate 2 chillers in the LEAD/LAG mode. It also provides the additional ability to start a designated standby chiller when either the lead or lag chiller is faulted and capacity requirements are not met. The lead/lag option operates in CCN mode only. If any other chiller configured for lead/lag is set to the LOCAL or OFF modes, it will be unavailable for lead/lag operation.

NOTE: Lead/Lag configuration is viewed and edited in LEAD/LAG, under the Equipment Configuration table of the Service menu. Lead/lag status during machine operation is viewed in the MAINT04 table in the Control Algorithm Status table.

Lead/Lag Chiller Configuration and Operation — The configured lead chiller is identified when the LEAD/LAG SELECT value for that chiller is configured to the value of "1." The configured lag chiller is identified when the LEAD/LAG SELECT for that chiller is configured to the value of "2." The standby chiller is configured to a value of "3." A value of "0" disables the lead/lag in that chiller.

To configure the LAG ADDRESS value on the LEAD/LAG Configuration table, always use the address of the other chiller on the system for this value. Using this address will make it easier to rotate the lead and lag machines.

If the address assignments placed into the LAG ADDRESS and STANDBY ADDRESS values conflict, the lead/lag will be disabled and an alert (!) message will occur. For example, if the LAG ADDRESS matches the lead machine's address, the lead/lag will be disabled and an alert (!) message will occur. The lead/lag maintenance screen (MAINT04) will display the message 'INVALID CONFIG' in the LEAD/LAG CONFIGURATION and CURRENT MODE fields.

The lead chiller responds to normal start/stop controls such as occupancy schedule, forced start/stop, and remote start contact inputs. After completing start up and ramp loading, the PIC evaluates the need for additional capacity. If additional capacity is needed, the PIC initiates the start up of the chiller configured at the LAG ADDRESS. If the lag chiller is faulted (in alarm) or is in the OFF or LOCAL modes, then the chiller at the STANDBY ADDRESS (if configured) is requested to start. After the second chiller is started and is running, the lead chiller shall monitor conditions and evaluate whether the capacity has reduced enough for the lead chiller to sustain the system alone. If the capacity is reduced enough for the lead chiller to sustain the CONTROL POINT temperatures alone, then the operating lag chiller is stopped.

If the lead chiller is stopped in CCN mode for any reason other than an alarm (*) condition, then the lag and standby chillers are stopped. If the configured lead chiller stops for and alarm condition, then the configured lag chiller takes the lead chiller's place as the lead chiller and the standby chiller serves as the lag chiller.

If the configured lead chiller does not complete the start up before the PRESTART FAULT TIMER (user configured value) elapses, then the lag chiller shall be started and the lead chiller will shut down. The lead chiller then monitors the start request from the acting lead chiller to start. The PRESTART FAULT TIMER is initiated at the time of a start request. The PRESTART FAULT TIMER's function is to provide a timeout in the event that there is a prestart alert condition preventing the machine from starting in a timely manner. The timer is configured under LEAD/LAG, found in the Equipment Configuration table of the Service menu.

If the lag chiller does not achieve start up before the PRESTART FAULT TIMER elapses, then the lag chiller shall be stopped and the standby chiller will be requested to start, if configured and ready.

Standby Chiller Configuration and Operation — The configured standby chiller is identified as such by having the LEAD/LAG SELECT configured to the value of ''3.'' The standby chiller can only operate as a replacement for the lag chiller if one of the other two chillers is in an alarm (!) condition (as shown on the LID panel). If both lead and lag chillers are in an alarm (!) condition, the standby chiller shall default to operate in CCN mode based on its configured Occupancy Schedule and remote contacts input.

Lag Chiller Start-Up Requirements — Before the lag chiller can be started, the following conditions must be met:

1. Lead chiller ramp loading must be complete.
2. Lead chiller CHILLED WATER temperature must be greater than the CONTROL POINT plus 1/2 the WATER/BRINE DEADBAND.

NOTE: The chilled water temperature sensor may be the leaving chilled water sensor, the return water sensor, the common supply water sensor, or the common return water sensor, depending on which options are configured and enabled.

3. Lead chiller ACTIVE DEMAND LIMIT value must be greater than 95% of full load amps.
4. Lead chiller temperature pulldown rate of the CHILLED WATER temperature is less than 0.5° F (0.27° C) per minute.
5. The lag chiller status indicates it is in CCN mode and is not faulted. If the current lag chiller is in an alarm condition, then the standby chiller becomes the active lag chiller, if it is configured and available.
6. The configured LAG START TIMER entry has elapsed. The LAG START TIMER shall be started when the lead chiller ramp loading is completed. The LAG START TIMER entry is accessed by selecting LEAD/LAG from the Equipment Configuration table of the Service menu.

When all of the above requirements have been met, the lag chiller is forced to a START mode. The PIC control then monitors the lag chiller for a successful start. If the lag chiller fails to start, the standby chiller, if configured, is started.

Lag Chiller Shutdown Requirements — The following conditions must be met in order for the lag chiller to be stopped.

1. Lead chiller COMPRESSOR MOTOR LOAD value is less than the lead chiller percent capacity.

NOTE: Lead chiller percent capacity = 100 −LAG PERCENT CAPACITY

The LAG PERCENT CAPACITY value is configured on the Lead/Lag Configuration screen.

2. The lead chiller chilled water temperature is less than the CONTROL POINT plus 1/2 of the WATER/BRINE DEADBAND.
3. The configured LAG STOP TIMER entry has elapsed. The LAG STOP TIMER is started when the CHILLED WATER TEMPERATURE is less than the CHILLED WATER CONTROL POINT plus 1/2 of the WATER/BRINE DEADBAND and the lead chiller COMPRESSOR MOTOR LOAD is less than the lead chiller percent capacity. The timer is ignored if the chilled water temperature reaches 3° F (1.67° C) below the CONTROL POINT and the lead chiller COMPRESSOR MOTOR LOAD value is less than the lead chiller percent capacity.

FAULTED CHILLER OPERATION — If the lead chiller shuts down on an alarm (*) condition, it stops communication to the lag and standby chillers. After 30 seconds, the lag chiller will now become the acting lead chiller and will start and stop the standby chiller, if necessary.

If the lag chiller faults when the lead chiller is also faulted, the standby chiller reverts to a stand-alone CCN mode of operation.

If the lead chiller is in an alarm (!) condition (as shown on the LID panel), the RESET softkey is pressed to clear the alarm, and the chiller is placed in the CCN mode, the lead chiller will now communicate and monitor the RUN STATUS of the lag and standby chillers. If both the lag and standby chillers are running, the lead chiller will not attempt to start and will not assume the role of lead chiller until either the lag or standby chiller shuts down. If only one chiller is running, the lead chiller will wait for a start request from the operating chiller. When the configured lead chiller starts, it assumes its role as lead chiller.

LOAD BALANCING — When the LOAD BALANCE OPTION is enabled, the lead chiller will set the ACTIVE DEMAND LIMIT in the lag chiller to the lead chiller's COMPRESSOR MOTOR LOAD value. This value has limits of 40% to 100%. When setting the lag chiller ACTIVE DEMAND LIMIT, the CONTROL POINT shall be modified to a value of 3° F (1.67° C) less than the lead chiller's CONTROL POINT value. If the LOAD BALANCE OPTION is disabled, the ACTIVE DEMAND LIMIT and the CONTROL POINT are forced to the same value as the lead chiller.

AUTORESTART AFTER POWER FAILURE — When an autorestart condition occurs, each chiller may have a delay added to the start-up sequence, depending on its lead/lag configuration. The lead chiller does not have a delay. The lag chiller has a 45-second delay. The standby chiller has a 90-second delay. The delay time is added after the chiller water flow verification. The PIC controls ensure that the slide valves are closed. After the slide valve position is confirmed, the delay for lag and standby chiller occurs prior to energizing the compressor. The normal start-up sequence then continues. The autorestart delay sequence occurs whether the chiller is in CCN or LOCAL mode and is intended to stagger the compressor motors from being energized simultaneously. This will help reduce the inrush demands on the building power system.

Ice Build Control

IMPORTANT: The Ice Build control option is only available on machines with PSIO Software Version 13 and higher.

Ice build control automatically sets the chilled WATER/BRINE CONTROL POINT of the machine to a temperature where an ice building operation for thermal storage can be accomplished.

NOTE: For ice build control to properly operate, the PIC controls must be placed in CCN mode. See Fig. 20 and 21.

The PIC can be configured for ice build operation. Configuration of ice build control is accomplished through entries in the Config table, Ice Build Setpoint table, and the Ice Build Time Schedule table. Figures 20 and 21 show how to access each entry.

The Ice Build Time Schedule defines the period during which ice build is activate if the ice build option is ENABLED. If the Ice Build Time Schedule overlaps other schedules defining time, then the Ice Build Time Schedule shall take priority. During the ice build period, the WATER/BRINE CONTROL POINT is set to the ICE BUILD SETPOINT for temperature control. The ICE BUILD RECYCLE OPTION and ICE BUILD TERMINATION entries from a screen in the Config (configuration) table provide options for machine recycle and termination of ice build cycle, respectively. Termination of ice build can result from the ENTERING CHILLED WATER/BRINE temperature being less than the ICE BUILD SETPOINT, opening of the REMOTE CONTACT inputs from an ice level indicator, or reaching the end of the Ice Build Time Schedule.

ICE BUILD INITIATION — The Ice Build Time Schedule provides the means for activating ice build. The ice build time table is named OCCPC02S.

If the Ice Build Time Schedule is OCCUPIED and the ICE BUILD OPTION is ENABLED, then ice build is active and the following events automatically take place (unless overridden by a higher authority CCN device):

1. Force CHILLER START/STOP to START.
2. Force WATER/BRINE CONTROL POINT to the ICE BUILD SETPOINT.
3. Remove any force (Auto) on the ACTIVE DEMAND LIMIT.

NOTE: Items 1-3 (shown above) shall not occur if the chiller is configured and operating as a lag or standby chiller for lead/lag and is actively controlled by a lead chiller. The lead chiller communicates the ICE BUILD SETPOINT, desired CHILLER START/STOP state, and ACTIVE DEMAND LIMIT to the lag or standby chiller as required for ice build, if configured to do so.

START-UP/RECYCLE OPERATION — If the machine is not running when ice build activates, then the PIC checks the following parameters, based on the ICE BUILD TERMINATION value, to avoid starting the compressor unnecessarily:

- if ICE BUILD TERMINATION is set to the TEMPERATURE ONLY OPTION and the ENTERING CHILLED WATER temperature is less than or equal to the ICE BUILD SETPOINT;
- if ICE BUILD TERMINATION is set to the CONTACTS ONLY OPTION and the remote contacts are open;
- if the ICE BUILD TERMINATION is set to the BOTH (temperature and contacts) option and ENTERING CHILLED WATER temperature is less than or equal to the ICE BUILD SETPOINT and remote contacts are open.

The ICE BUILD RECYCLE OPTION determines whether or not the PIC will go into a RECYCLE mode. If the ICE BUILD RECYCLE OPTION is set to DSABLE (disable) when the ice build terminates, the PIC will revert back to normal temperature control duty. If the ICE BUILD RECYCLE OPTION is set to ENABLE, when ice build terminates, the PIC will go into an ICE BUILD RECYCLE mode and the chilled water pump relay will remain energized to keep the chilled water flowing. If the entering CHILLED WATER/BRINE TEMPERATURE increases above the ICE BUILD SETPOINT plus the RECYCLE DELTA T value, the compressor will restart and control the CHILLED WATER/BRINE TEMPERATURE to the ICE BUILD SETPOINT.

TEMPERATURE CONTROL DURING ICE BUILD —During ice build, the capacity control algorithm uses the WATER/BRINE CONTROL POINT minus 5 F (2.7 C) to control the LEAVING CHILLED WATER temperature. The ECW OPTION and any temperature reset option are ignored during ice build. The 20 mA DEMAND LIMIT OPTION is also ignored during ice build.

TERMINATION OF ICE BUILD — Ice build termination occurs under the following conditions:

1. Ice Build Time Schedule — When the Ice Build Time Schedule transitions to UNOCCUPIED, ice build operation shall terminate.
2. ECW TEMPERATURE — Termination of compressor operation, based on temperature, shall occur if the ICE BUILD TERMINATION is set to the ICE BUILD TERMINATION TEMP option and the ENTERING CHILLED WATER temperature is less than the ICE BUILD SETPOINT. If the ICE BUILD RECYCLE OPTION is set to ENABLE, a recycle shutdown occurs and recycle start-up shall be based on LEAVING CHILLED WATER temperature being greater than the WATER/BRINE CONTROL POINT plus RECYCLE DELTA T.
3. Remote Contacts/Ice Level Input- Termination of compressor operation occurs when ICE BUILD TERMINATION is set to CONTACTS ONLY OPTION and the remote contacts are open. In this case, the contacts are provided for ice level termination control. The remote contacts can still be opened and closed to start and stop the chiller when the Ice Build Time Schedule is UNOCCUPIED. The contacts are used to stop the ICE BUILD mode when the Ice Build Time Schedule is OCCUPIED.
4. ECW TEMPERATURE and Remote Contacts — Termination of compressor operation shall occur when ICE BUILD TERMINATION is set to BOTH (temperature and contacts) option and the previously described conditions for ECW TEMPERATURE and remote contacts have occurred.

NOTE: Overriding the CHILLER START/STOP, WATER/BRINE CONTROL POINT, and ACTIVE DEMAND LIMIT variables by CCN devices (with a priority less than 4) during the ice build period is not possible. However, overriding can be accomplished with CCN during two chiller lead/lag.

RETURN TO NON-ICE BUILD OPERATIONS — Upon termination of ice build, the machine shall return to normal temperature control and start/stop schedule operation. If the CHILLER START/STOP or WATER/BRINE CONTROL POINT has been forced (with a priority less than 4), prior to entering ice build operation, then chiller START/STOP and WATER/BRINE CONTROL POINT forces will be removed.

Attach to Network Device Control — On the Service menu, one of the selections is ATTACH TO NETWORK DEVICE. This table serves the following purposes:

- to upload new parameters when switching the controller to HFC-134a refrigerant.
- to upload the Occupancy Schedule Number (if changed) for OCCPC03S, as defined in the Service01 table
- to attach the LID to any CCN device, if the machine has been connected to a CCN Network. This may include other PIC controlled chillers.
- to change to a new PSIO or LID module or upgrade software.

Figure 26 illustrates the ATTACH TO NETWORK DEVICE table. The Local description is always the PSIO module address of the machine the LID is mounted on. Whenever the controller identification of the PSIO is changed, this change is reflected on the bus and address for the LOCAL DEVICE of the ATTACH TO DEVICE screen automatically.

Whenever the ATTACH TO NETWORK DEVICE table is entered, the LID erases information on the module to which it was attached in order to make room for another device. Therefore, it is then required to attach to a CCN module when this screen is entered, even if the LID is attached back to the original module. When the ATTACH softkey is pressed, the message ''UPLOADING TABLES, PLEASE WAIT'' flashes. The LID will then upload the highlighted device or module. If the module address cannot be found, the message ''COMMUNICATION FAILURE'' will appear. The LID will then revert back to the ATTACH TO DEVICE screen. The upload process time for various CCN modules is different for each module. In general, the uploading process will take 3 to 5 minutes.

CHANGING REFRIGERANT TYPES — To select refrigerant type, go to the Control Test table. Whenever the refrigerant type is changed, the ATTACH TO NETWORK DEVICE table must be used. After changing the refrigerant type in the Control Test table, move to the ATTACH TO NETWORK DEVICE table. Make sure the highlight bar is located on the LOCAL selection. Press the ATTACH softkey. The information in the PSIO module will now be uploaded. The default screen will appear. The new refrigerant type change for the controller is complete.

NOTE: Refrigerant type can be changed on Frame 4 machines only.

ATTACHING TO OTHER CCN MODULES — If the machine PSIO has been connected to a CCN Network or other PIC controlled chillers through CCN wiring, the LID can be used to view or change parameters on the other controllers. Other PIC machines can be viewed and set points changed (if the other unit is in CCN control), if desired from this particular LID module.

To view the other devices, move to the ATTACH TO NETWORK DEVICE table. Move the highlight bar to any device number. Press SELECT softkey to change the bus number and address of the module to be viewed. Press EXIT softkey to move back to the ATTACH TO NETWORK DEVICE table. If the module number is not valid, the ''COMMUNICATION FAILURE'' message will show and a new address number should be entered or the wiring checked. If the model is communicating properly, the ''UPLOAD IN PROGRESS'' message will flash and the new module can now be viewed.

Whenever there is a question regarding which module on the LID is currently being shown, check the device name descriptor on the upper left hand corner of the LID screen. See Fig. 26.

When the CCN device has been viewed, the ATTACH TO NETWORK DEVICE table should now be used to attach to the PIC that is on the machine. Move to the ATTACH TO NETWORK DEVICE table and press the ATTACH softkey to upload the LOCAL device. The PSIO for the 23XL will now be uploaded.

NOTE: The LID will not automatically re-attach to the PSIO module on the machine. Press the ATTACH softkey to attach to LOCAL DEVICE and view the machine PSIO.

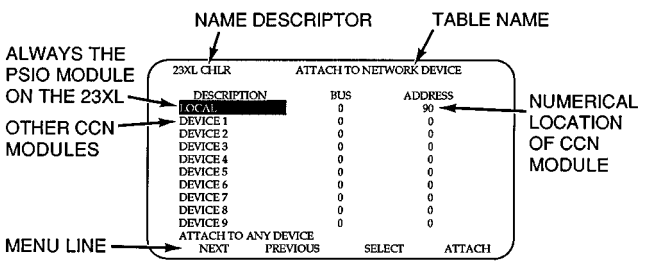
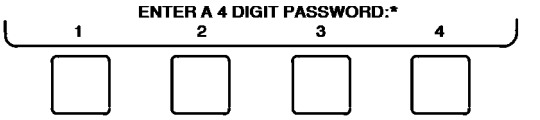


Fig. 26 — Example of Attach to Network Device Table

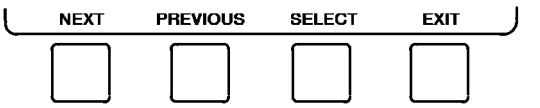
Service Operation — An overview of the menu-driven programs available for Service Operation is shown in Fig. 21.

TO LOG ON

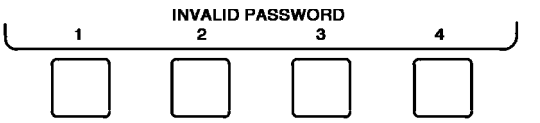
1. On the Menu screen, press SERVICE. The keys now correspond to the numerals 1, 2, 3, 4.
2. Press the four digits of your password, one at a time. An asterisk (*) appears as you enter each digit.



The menu bar (Next-Previous-Select-Exit) is displayed to indicate that you have successfully logged on.



If the password is entered incorrectly, an error message is displayed. If this occurs, return to Step 1 and try logging on again.



NOTE: The initial factory set password is 1-1-1-1.

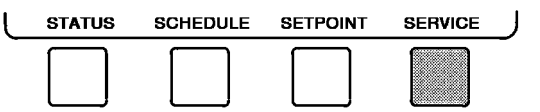
TO LOG OFF — Access the Log Out of Device table of the Service menu in order to password-protect the Service menu. The LID will automatically sign off and password-protect itself if a key is not pressed for 15 minutes. The LID default screen is then displayed.

HOLIDAY SCHEDULING (Fig. 27) — The time schedules may be configured for special operation during a holiday period. When modifying a time period, the ''H'' at the end of the days of the week field signifies that the period is applicable to a holiday. (See Fig 22.)

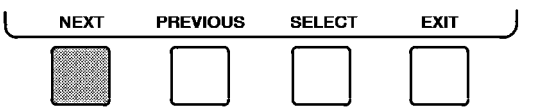
The Broadcast function must be activated for the holidays configured in the Holidef tables to work properly. Access the Brodefs table in the Equipment Configuration menu and answer ''Yes'' to the activated function. However, when the machine is connected to a CCN Network, only one machine or CCN device can be configured to be the broadcast device. The controller that is configured to be the broadcaster is the device responsible for transmitting holiday, time, and daylight-savings dates throughout the network.

To view or change the holiday periods for up to 18 different holidays, perform the following operation:

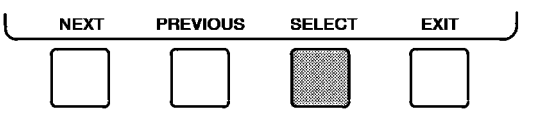
1. At the Menu screen, press SERVICE to access the Service menu.



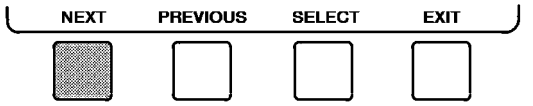
2. If not logged on, follow the instructions for To Log On or To Log Off. Once logged on, press NEXT until Equipment Configuration is highlighted.



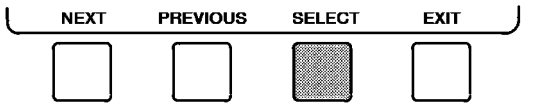
3. Once Equipment Configuration is highlighted, press SELECT to access.



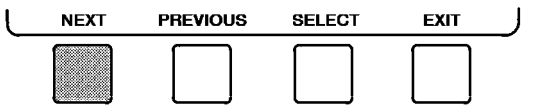
4. Press NEXT until Holidef is highlighted. This is the Holiday Definition table.



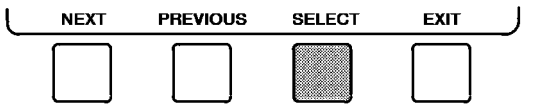
5. Press SELECT to enter the Data Table Select screen. This screen lists 18 holiday tables.



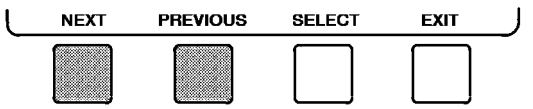
6. Press NEXT to highlight the holiday table that you wish to view or change. Each table is one holiday period, starting on a specific date, and lasting up to 99 days.



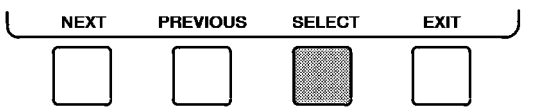
7. Press SELECT to access the holiday table. The Configuration Select table now shows the holiday start month and day, and how many days the holiday period will last.



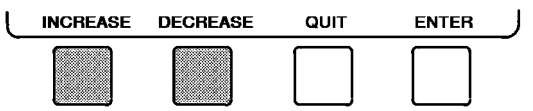
8. Press NEXT or PREVIOUS to highlight the month, day, or duration.



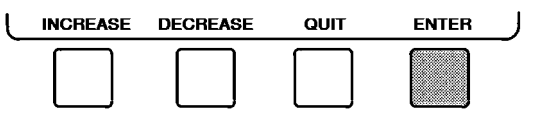
9. Press SELECT to modify the month, day, or duration.



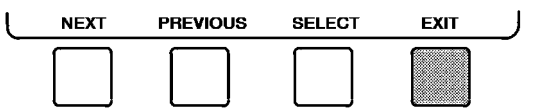
10. Press INCREASE or DECREASE to change the selected value.



11. Press ENTER to save the changes.



12. Press EXIT to return to the previous menu.



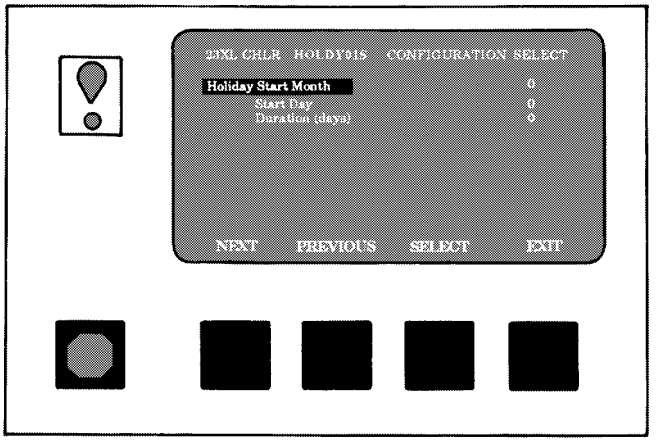


Fig. 27 — Example of Holiday Period Screen

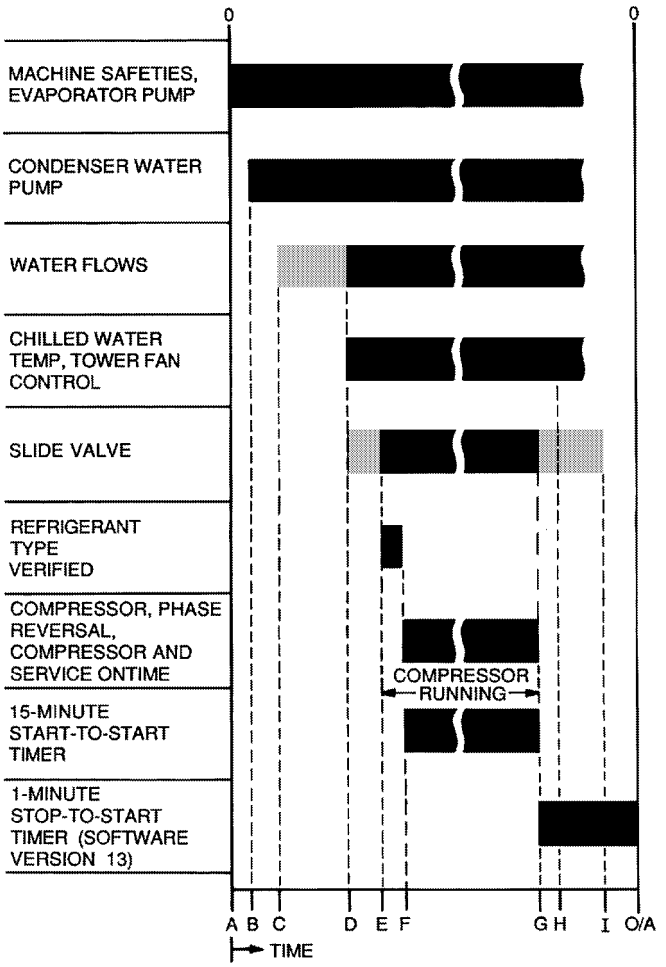
START-UP/SHUTDOWN/ RECYCLE SEQUENCE (Fig. 28)

Local Start-Up — Local start-up (or a manual start-up) is initiated by pressing the LOCAL menu softkey which is on the LID default screen. Local start-up can proceed when Time Schedule 01 is in OCCUPIED mode, and after the internal 15-minute start-to-start and the 1-minute stop-to-start timer on PSIO Software Version 13 and higher have expired. PSIO Software Version 12 and lower has a 3-minute stop-to-start timer.

The chiller start/stop status point on the Status01 table may be overridden to start, regardless of the time schedule, in order to locally start the unit. Also, the remote contacts may be enabled through the LID and closed to initiate a start-up.

Whenever the chiller is in LOCAL control mode, the PIC will wait for Time Schedule 01 to become occupied, and the remote contacts to close, if enabled. The PIC will then perform a series of pre-start checks to verify that all pre-start alerts and safeties are within the limits shown in Table 4. The run status line on the LID now reads ''Starting.'' If the checks are successful, the chilled water/brine pump relay will be energized. Five seconds later, the condenser pump relay is energized. One minute later the PIC monitors the chilled water and condenser flow switches. The PIC waits up to the *WATER FLOW VERIFY TIME* (operator configured, default 5 minutes) to confirm flow. After flow is verified, the CHILLED WATER/BRINE temperature is compared to *CONTROL POINT* plus *DEADBAND*. If the temperature is less than or equal to the CONTROL POINT plus DEADBAND, the PIC will turn off the condenser pump and go into the RECYCLE mode. If the water/brine temperature is high enough, the start-up sequence continues to check the slide valve decrease timer. If the slide valve has been unloading for at least 3 minutes since the last machine shutdown, then the refrigerant type is verified. The compressor start relay (1CR) is energized to start the compressor 10 seconds later.

Failure to verify any of the requirements up to this point will result in the PIC aborting the start and displaying the applicable pre-start mode of failure on the LID default screen. A pre-start failure does not advance the starts in 12 hours counter. Any failure after the 1CR relay has energized results in a safety shutdown, advances the starts in 12 hours counter by one, and displays the applicable shutdown status on the LID display.



A — START INITIATED: Pre-start checks are made; evaporator pump started
B — Condenser water pump started (5 seconds after A)
C — Water flows verified (30 seconds to 5 minutes maximum)
D — Chilled water temperature checked against control point; tower fan control enabled; slide valve decrease timer checked to verify slide valve position
E — Refrigerant type verified (up to 3 minutes after D).
F — Compressor motor starts; phase reversal conditions monitored; compressor ontime and service ontime start; 15-minute inhibit timer starts (10 seconds after E)
G — Shutdown initiated: Compressor motor stops; compressor ontime and service ontime stop; 3-minute inhibit timer starts on PSIO Software Version 8 and 12 and 1-minute inhibit timer on PSIO Software Version 13 and higher; slide valve decrease activated for 1 minute
H — Evaporator pump deenergized (30 seconds after G); condenser pump and tower fan control may continue to operate if condenser pressure is high; evaporator pump may continue if in RECYCLE mode
I — Slide valve decrease timer expires (3 minutes after G)
O/A — Restart permitted (both inhibit timers expired) (minimum of 15 minutes after F; minimum of 1 minute after G)

Fig. 28 — Control Sequence

Shutdown Sequence — Shutdown of the machine can occur if any of the following events happen:

- the STOP button is pressed for at least one second (the alarm light will blink once to confirm stop command)
- recycle condition is present (see Chilled Water Recycle Mode section)
- time schedule has gone into UNOCCUPIED mode (machine protective limit has been reached and machine is in alarm)
- the start/stop status is overridden to stop from the CCN network or the LID

When a stop signal occurs, the shutdown sequence first stops the compressor by deactivating the start relay. The slide valve decrease timer is activated for 3 minutes to open the slide valve. The condenser water pump relay is shut down 30 seconds after the compressor run contact is open and motor load is less than 10%. The service ontime and compressor ontime timers are deactivated. The 3-minute stop-to-start timer will now begin to count down. If the 15-minute start-to-start timer is still greater than 3 minutes, then this time is now displayed. Last, the chilled water/brine pump is shut down.

Certain conditions during shutdown will change this sequence:

- if the *COMPRESSOR MOTOR LOAD* is greater than 10% after shutdown, or the starter contacts remain energized, the chilled water pump and the condenser water pump remain energized and the alarm is displayed
- if the *ENTERING CONDENSER WATER* temperature is less than 115 F (46 C) [125 F (52 C)] and the condenser refrigerant temperature is less than the CONDENSER FREEZE POINT plus 5° F (3° C) at shutdown, the Condenser Pump Control algorithm will determine when the condenser pump will be deenergized after shutdown
- if the machine shuts down due to low refrigerant temperature, the chilled water pump will stay running until the *LEAVING CHILLED WATER* is greater than *CONTROL POINT,* plus 5° F (3° C).

Automatic Soft Stop Amps Threshold (PSIO Software Version 13 and Higher) — The SOFT STOP AMPS THRESHOLD unloads the slide valve of the compressor automatically when a non-recycle, non-alarm stop signal is emitted before the compressor motor is deenergized.

If the STOP button is pressed, the slide valve unloads to a preset amperage percent. Then, the compressor will shut off.

If the machine enters an Alarm state or if the compressor enters a RECYCLE mode, the compressor will be deenergized immediately.

To activate SOFT STOP AMPS THRESHOLD, view the bottom of Service1 screen. Set the Soft Stop Amps Threshold value to the percentage amps that the slide valve will achieve the motor will be shut down. The default setting is 100% (no Soft Stop).

When the SOFT STOP AMPS THRESHOLD is being applied, a status message ''SHUTDOWN IN PROGRESS, COMPRESSOR UNLOADING'' is shown.

Chilled Water Recycle Mode — When the compressor is running in a lightly loaded condition, the machine may cycle off and wait until the load increases before restarting. This cycling of the chiller is normal and is known as recycle. A recycle shutdown is initiated when any of the following conditions are present:

- when in LCW control, the *LEAVING CHILLED WATER* temperature is more than 5° F (3° C) below the control point, and the *CONTROL POINT* has not increased in the last 5 minutes
- when *ECW CONTROL OPTION* is enabled, the *ENTERING CHILLED WATER* temperature is more than 5° F (3° C) below the *CONTROL POINT*, and the *CONTROL POINT* has not increased in the last 10 minutes
- when the *LEAVING CHILLED WATER* temperature is within 3° F (2° C) of the *BRINE REFRIG TRIPPOINT*

When the machine is in RECYCLE mode, the chilled water pump relay remains energized so that the chilled water temperature can be monitored for increasing load. The recycle control uses *RECYCLE RESTART DELTA T* to check when the compressor should be restarted. RECYCLE RESTART DELTA T is an operator-configured function which defaults to 5 F (3 C). This value is viewed/modified on the Service1 screen. The compressor will restart when:

- in LCW CONTROL the *LEAVING CHILLED WATER* temperature is greater than the *CONTROL POINT* plus the *RECYCLE RESTART DELTA T;* or
- in ECW CONTROL, the *ENTERING CHILLED WATER* temperature is greater than the *CONTROL POINT* plus the *RECYCLE RESTART DELTA T*

Once these conditions are met, the compressor shall initiate a start-up, with a normal start-up sequence.

An Alert condition may be generated if 5 or more RECYCLE STARTUPs occur in less than 4 hours. This excessive recycling can reduce machine life. Compressor recycling due to extremely low loads should be stopped. To stop compressor recycling, use the time schedule to shut the machine down during low load operation. Increase the machine load by running the fan systems. If the hot gas bypass is installed, adjust the values to ensure that hot gas is energized during light load conditions. Increase the RECYCLE RESTART DELTA T on the Service1 table. By increasing this value, the off time of the machine is increased.

The machine should not be operated below design minimum load.

Safety Shutdown — A safety shutdown is identical to a manual shutdown with the exception that the LID will display the reason for the shutdown, the alarm light will blink continuously, the default screen display will freeze, and the spare alarm contacts will be energized. A safety shutdown requires that the RESET softkey be pressed in order to clear the alarm. Before pressing the RESET softkey, record the default screen values. If the alarm is still present, the alarm light will continue to blink. Once the alarm is cleared, the operator must press the CCN or LOCAL softkey to restart the machine.

⚠ CAUTION

Do not reset starter loads or any other starter safety for 30 seconds after the compressor has stopped. Voltage output to the compressor start signal is maintained for 10 seconds to determine starter fault.

BEFORE INITIAL START-UP

Job Data Required

- list of applicable design temperatures and pressures (product data submittal)
- machine certified drawings
- starting equipment details and wiring diagrams
- diagrams and instructions for special controls or options
- 23XL Installation Instructions
- pumpout unit instructions

Field Supplied Equipment Required

- mechanic's tools (refrigeration)
- digital volt-ohmmeter (DVM)
- clamp-on ammeter
- electronic leak detector
- absolute pressure manometer or wet-bulb vacuum indicator (Fig. 29)
- 500 v insulation tester (megohmmeter)

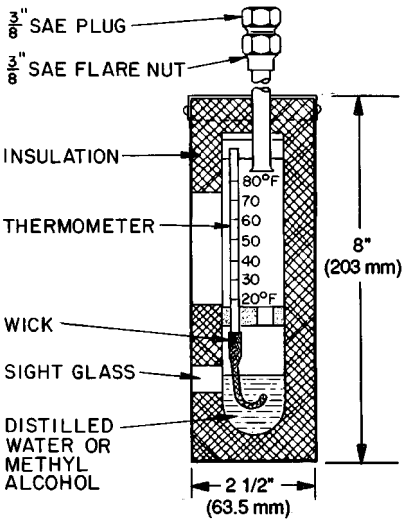


Fig. 29 — Typical Wet-Bulb Type Vacuum Indicator

Using the Optional Storage Tank and Pumpout System — Refer to Pumpout and Refrigerant Transfer Procedures section for pumpout system preparation, refrigerant transfer, and machine evacuation.

Remove Shipping Packaging — Remove any packaging material from the control center, power panel, slide valve assembly, motor temperature sensor cover, and the factory-mounted starter.

Open Oil Circuit Valves — Check that the oil filter isolation valves (Fig. 3 and 4) are open by removing the valve cap and checking the valve stem.

Check Machine Tightness — Figure 30 outlines the proper sequence and procedures for leak testing.

23XL machines are shipped with a full refrigerant and oil charge. Units may be ordered with the refrigerant shipped separately, and a 15 psig (103 kPa) nitrogen-holding charge in each vessel. To determine if there are any leaks, the machine should be charged with refrigerant. Use an electronic leak detector to check all flanges and solder joints after the machine is pressurized. If any leaks are detected, follow the leak test procedure.

If the machine is spring isolated, keep all springs blocked in both directions to prevent possible piping stress and damage when refrigerant is transferred from vessel to vessel during the leak test process or any time refrigerant is transferred. Adjust the springs when the refrigerant is in operating condition, and the water circuits are full.

Refrigerant Tracer — Carrier recommends the use of an environmentally acceptable refrigerant tracer for leak testing with an electronic detector or halide torch.

Ultrasonic leak detectors also can be used if the machine is under pressure.

⚠ WARNING

Do not use air or oxygen as a means of pressurizing the machine. Some mixtures of HCFC-22 or HFC-134a and air can undergo combustion.

Leak Test Machine — Due to regulations regarding refrigerant emissions and the difficulties associated with separating contaminants from refrigerant, Carrier recommends the following leak test procedures. See Fig. 30 for an outline of the leak test procedures. Refer to Fig. 24 and 25 during pumpout procedures. See the Pumpout and Refrigerant Transfer Procedures Section on page 61. Refer to Tables 6A-6D for temperature/pressure relationships for HCFC-22 and HFC-134a refrigerants. See Fig. 31-34.

1. If the pressure readings are normal for machine condition:
   a. Evacuate the holding charge from the vessels, if present.
   b. Raise the machine pressure, if necessary, by adding refrigerant until pressure is at equivalent saturated pressure for the surrounding temperature.

⚠ WARNING

Never charge liquid refrigerant into the machine if the pressure in the machine is less than 68 psig (469 kPa) [35 psig (241 kPa)]. Charge as a gas only, with the cooler and condenser pumps running, until this pressure is reached, using PUMPDOWN and TERMINATE PUMPDOWN/LOCKOUT mode on the PIC. Flashing of liquid refrigerant at low pressures can cause tube freeze-up and considerable damage.

   c. Leak test machine as outlined in Steps 3 - 7.
2. If the pressure readings are abnormal for machine condition:
   a. Prepare to leak test machines shipped with refrigerant. If machine is shipped with refrigerant, proceed to Step 2h.
   b. Check for large leaks by connecting a nitrogen bottle and raising the pressure to 30 psig (207 kPa). Soap test all joints. If the test pressure holds for 30 minutes, prepare the test for small leaks (Steps 2g - h).
   c. Plainly mark any leaks which are found.
   d. Release the pressure in the system.
   e. Repair all leaks.
   f. Retest only those joints that were repaired.
   g. After successfully completing the test for large leaks, remove as much nitrogen, air, and moisture as possible, given the fact that small leaks may be present in the system. This can be accomplished by following the dehydration procedure, outlined in the Machine Dehydration section, page 48.
   h. Slowly raise the system pressure to a maximum of 210 psig (1448 kPa) but no less than 68 psig (469 kPa) [35 psig (241 kPa)] by adding refrigerant. Proceed with the test for small leaks (Steps 3 - 7).
3. Check the machine carefully with an electronic leak detector, halide torch, or soap solution.
4. Leak Determination — If an electronic leak detector indicates a leak, use a soap bubble solution, if possible, to confirm. Total all leak rates for the entire machine. Leakage at rates greater than 1 lb/year (0.45 kg/year) for the entire machine must be repaired. Note total machine leak rate on the start-up report.
5. If no leak is found during initial start-up procedures, complete the transfer of refrigerant gas from the storage tank to the machine. Retest for leaks.
6. If no leak is found after a retest:
   a. Transfer the refrigerant to the storage tank and perform a standing vacuum test as outlined in the Standing Vacuum Test section, page 48.
   b. If the machine fails this test, check for large leaks (Step 2b).
   c. Dehydrate the machine if it passes the standing vacuum test. Follow the procedure in the Machine Dehydration section. Charge machine with refrigerant.
7. If a leak is found, pump the refrigerant back into the storage tank, or if isolation valves are present, pump into the vessel that is not leaking.

   Transfer the refrigerant until machine pressure is at least equal to the pressure specified by the EPA under 40CFR Part 82.

   Repair the leak and repeat the procedure, beginning from Step 2h to ensure a leaktight repair. If machine is opened to the atmosphere for an extended period, evacuate it before repeating leak test.

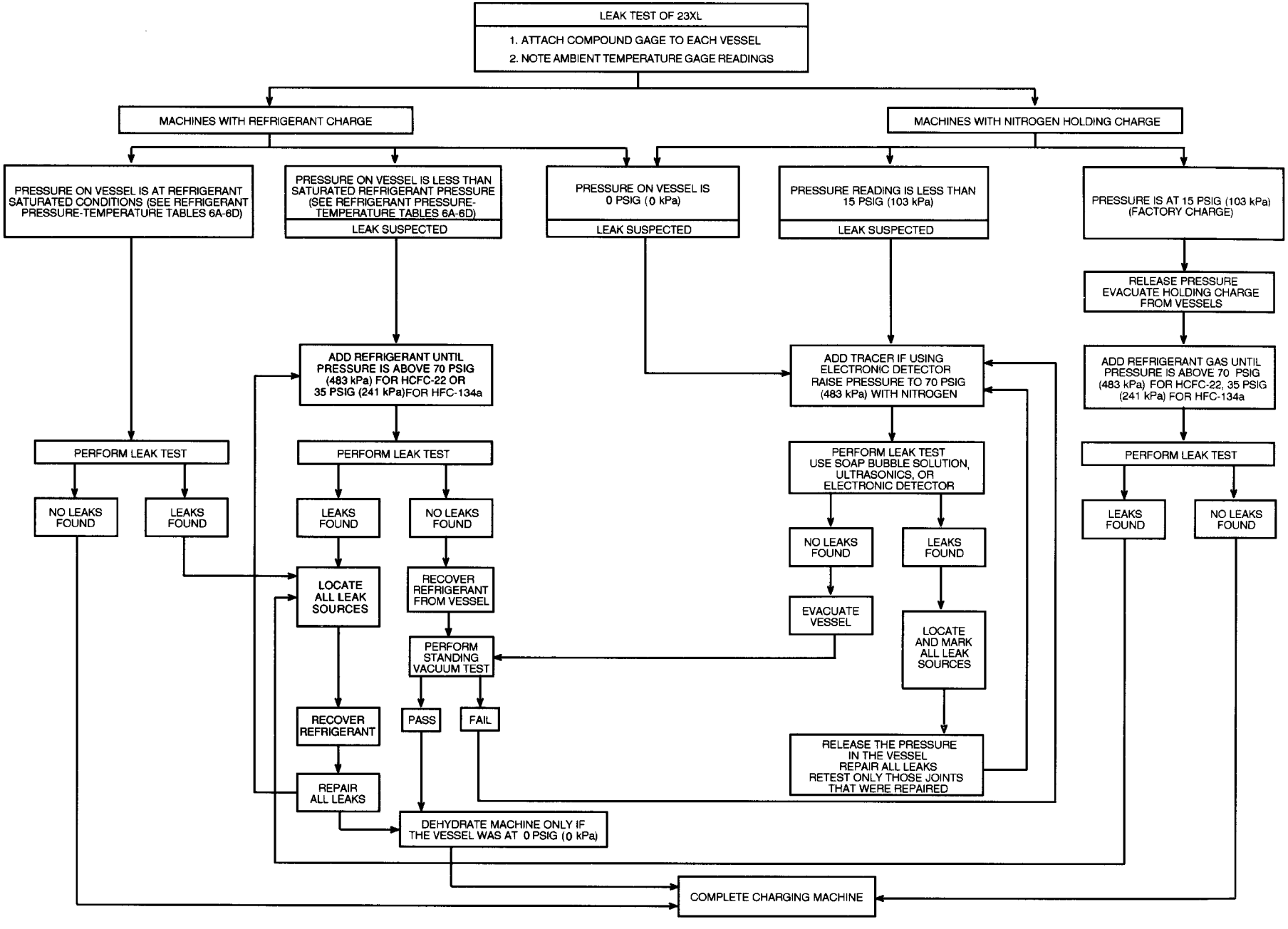

LEAK TEST OF 23XL
1. ATTACH COMPOUND GAGE TO EACH VESSEL
2. NOTE AMBIENT TEMPERATURE GAGE READINGS
MACHINES WITH REFRIGERANT CHARGE
MACHINES WITH NITROGEN HOLDING CHARGE
PRESSURE ON VESSEL IS AT REFRIGERANT SATURATED CONDITIONS (SEE REFRIGERANT PRESSURE-TEMPERATURE TABLES 6A-6D)
PRESSURE ON VESSEL IS LESS THAN SATURATED REFRIGERANT PRESSURE (SEE REFRIGERANT PRESSURE-TEMPERATURE TABLES 6A-6D)
LEAK SUSPECTED
PRESSURE ON VESSEL IS 0 PSIG (0 kPa)
LEAK SUSPECTED
PRESSURE READING IS LESS THAN 15 PSIG (103 kPa)
LEAK SUSPECTED
PRESSURE IS AT 15 PSIG (103 kPa) (FACTORY CHARGE)
RELEASE PRESSURE EVACUATE HOLDING CHARGE FROM VESSELS
ADD REFRIGERANT GAS UNTIL PRESSURE IS ABOVE 70 PSIG (483 kPa) FOR HCFC-22, 35 PSIG (241 kPa) FOR HFC-134a
ADD REFRIGERANT UNTIL PRESSURE IS ABOVE 70 PSIG (483 kPa) FOR HCFC-22 OR 35 PSIG (241 kPa)FOR HFC-134a
ADD TRACER IF USING ELECTRONIC DETECTOR RAISE PRESSURE TO 70 PSIG (483 kPa) WITH NITROGEN
PERFORM LEAK TEST
PERFORM LEAK TEST
PERFORM LEAK TEST USE SOAP BUBBLE SOLUTION, ULTRASONICS, OR ELECTRONIC DETECTOR
PERFORM LEAK TEST
NO LEAKS FOUND
LEAKS FOUND
LEAKS FOUND
NO LEAKS FOUND
NO LEAKS FOUND
LEAKS FOUND
LEAKS FOUND
NO LEAKS FOUND
LOCATE ALL LEAK SOURCES
RECOVER REFRIGERANT FROM VESSEL
EVACUATE VESSEL
LOCATE AND MARK ALL LEAK SOURCES
PERFORM STANDING VACUUM TEST
RECOVER REFRIGERANT
PASS
FAIL
RELEASE THE PRESSURE IN THE VESSEL REPAIR ALL LEAKS RETEST ONLY THOSE JOINTS THAT WERE REPAIRED
REPAIR ALL LEAKS
DEHYDRATE MACHINE ONLY IF THE VESSEL WAS AT 0 PSIG (0 kPa)
COMPLETE CHARGING MACHINE

Fig. 30 — 23XL Leak Test Procedures

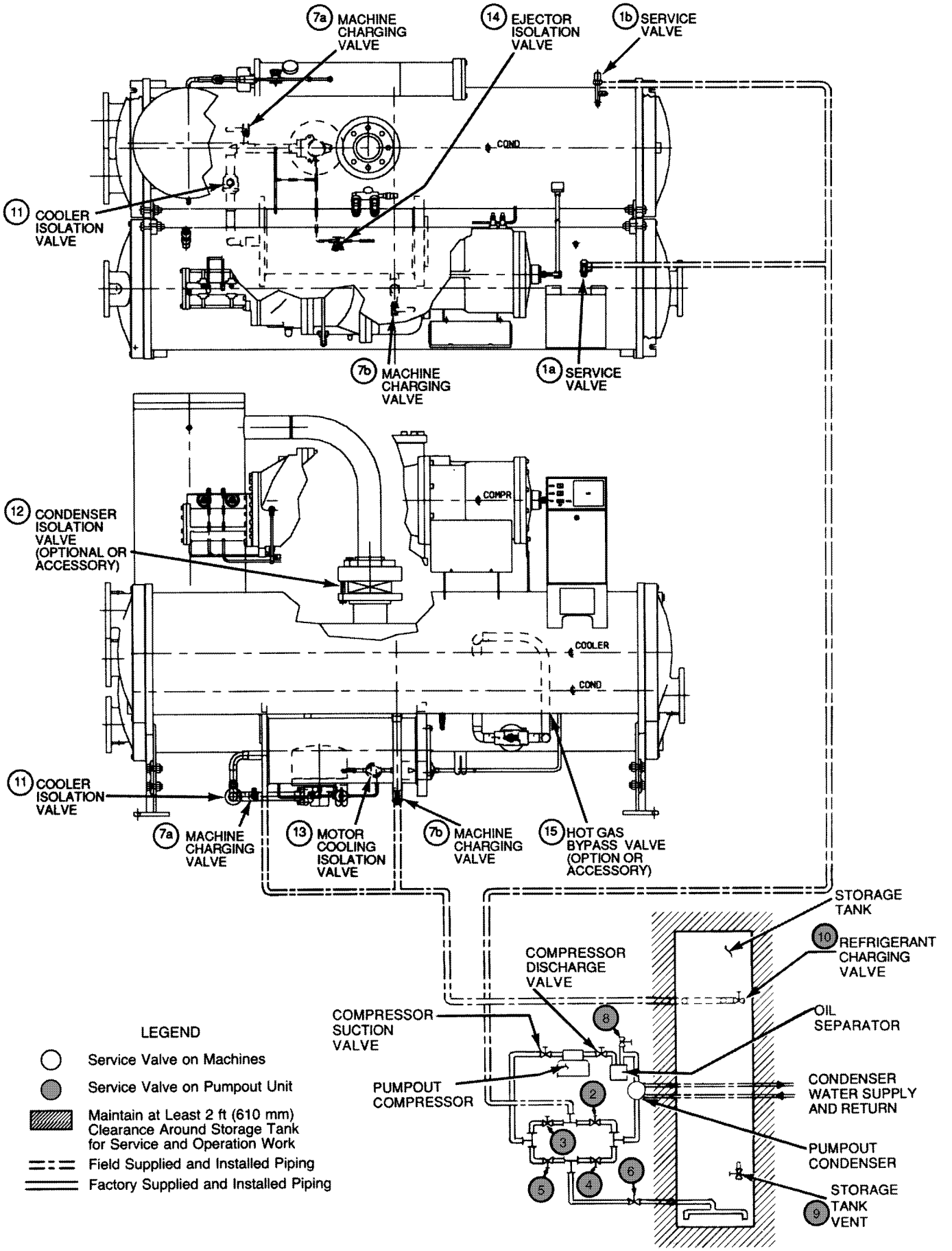


Fig. 31 — Typical Optional Pumpout System Piping Schematic with Storage Tank (Frame 1 and 2 Machines)

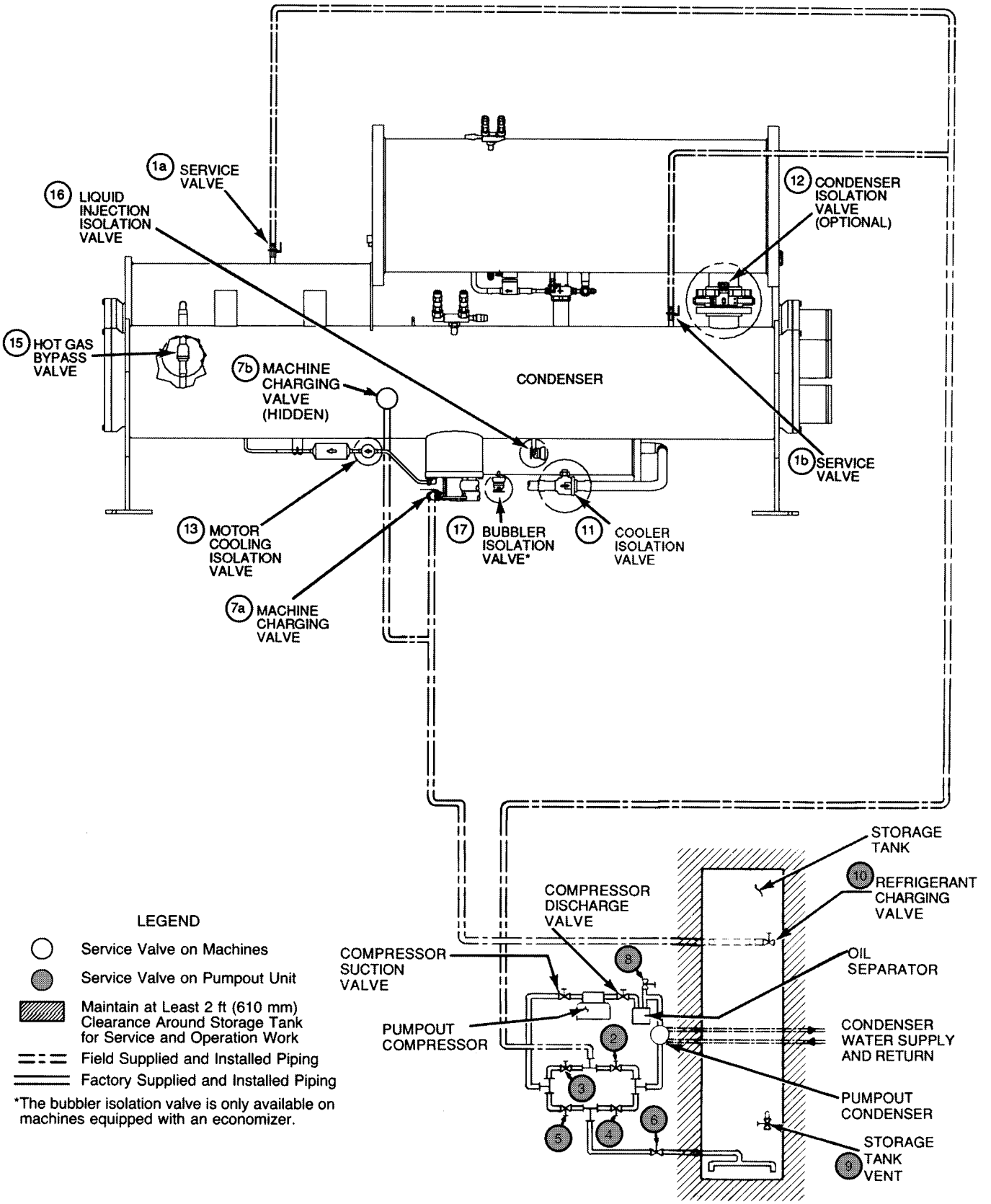

1a SERVICE VALVE
16 LIQUID INJECTION ISOLATION VALVE
12 CONDENSER ISOLATION VALVE (OPTIONAL)
15 HOT GAS BYPASS VALVE
7b MACHINE CHARGING VALVE (HIDDEN)
CONDENSER
1b SERVICE VALVE
13 MOTOR COOLING ISOLATION VALVE
17 BUBBLER ISOLATION VALVE*
11 COOLER ISOLATION VALVE
7a MACHINE CHARGING VALVE
STORAGE TANK
10 REFRIGERANT CHARGING VALVE
COMPRESSOR DISCHARGE VALVE
COMPRESSOR SUCTION VALVE
OIL SEPARATOR
PUMPOUT COMPRESSOR
CONDENSER WATER SUPPLY AND RETURN
PUMPOUT CONDENSER
STORAGE TANK VENT
LEGEND
Service Valve on Machines
Service Valve on Pumpout Unit
Maintain at Least 2 ft (610 mm) Clearance Around Storage Tank for Service and Operation Work
Field Supplied and Installed Piping
Factory Supplied and Installed Piping
*The bubbler isolation valve is only available on machines equipped with an economizer.

Fig. 32 — Typical Optional Pumpout System Piping Schematic With Storage Tank (Frame 4 Machines)

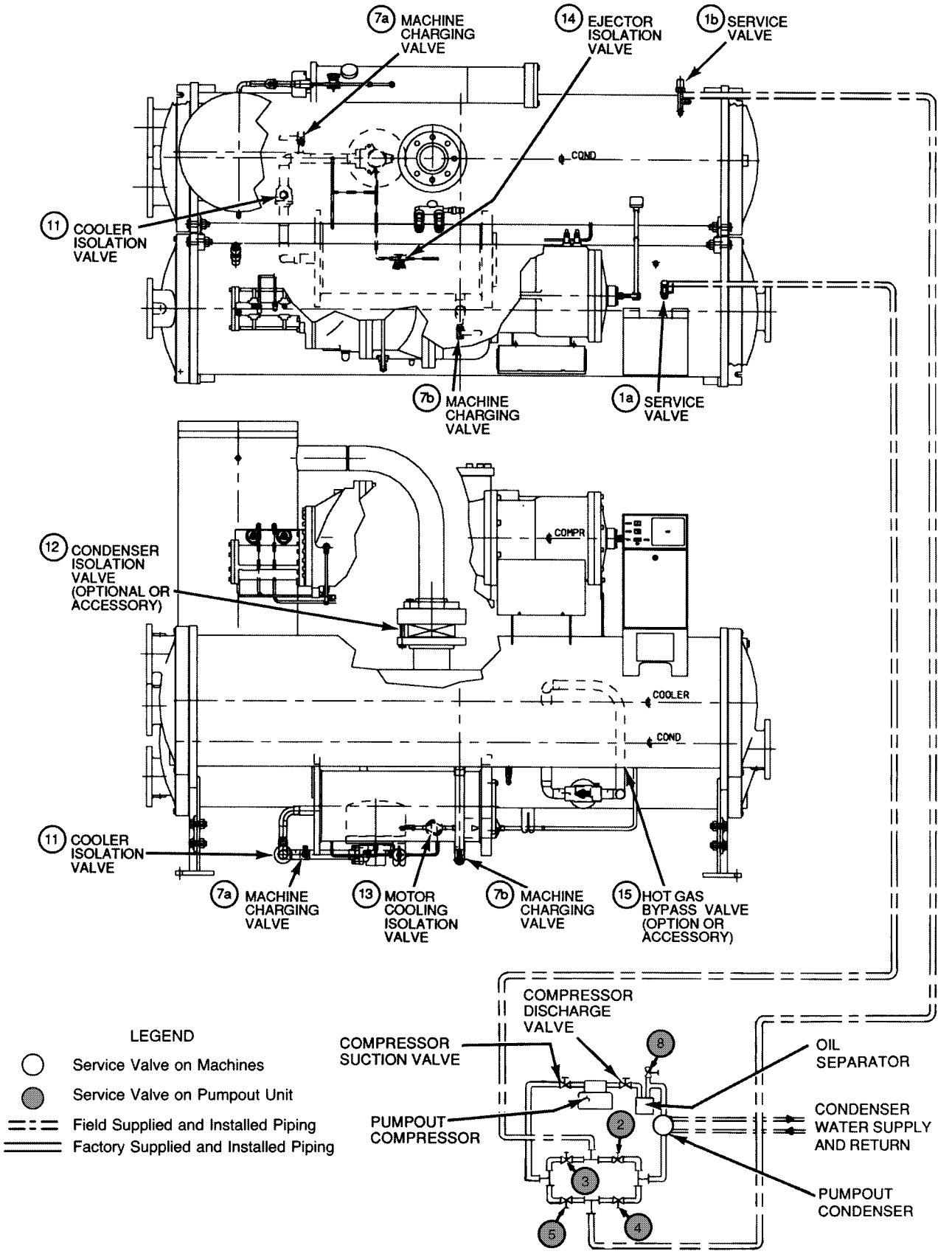


Fig. 33 — Typical Optional Pumpout System Piping Schematic Without Storage Tank (Frame 1 and 2 Machines)

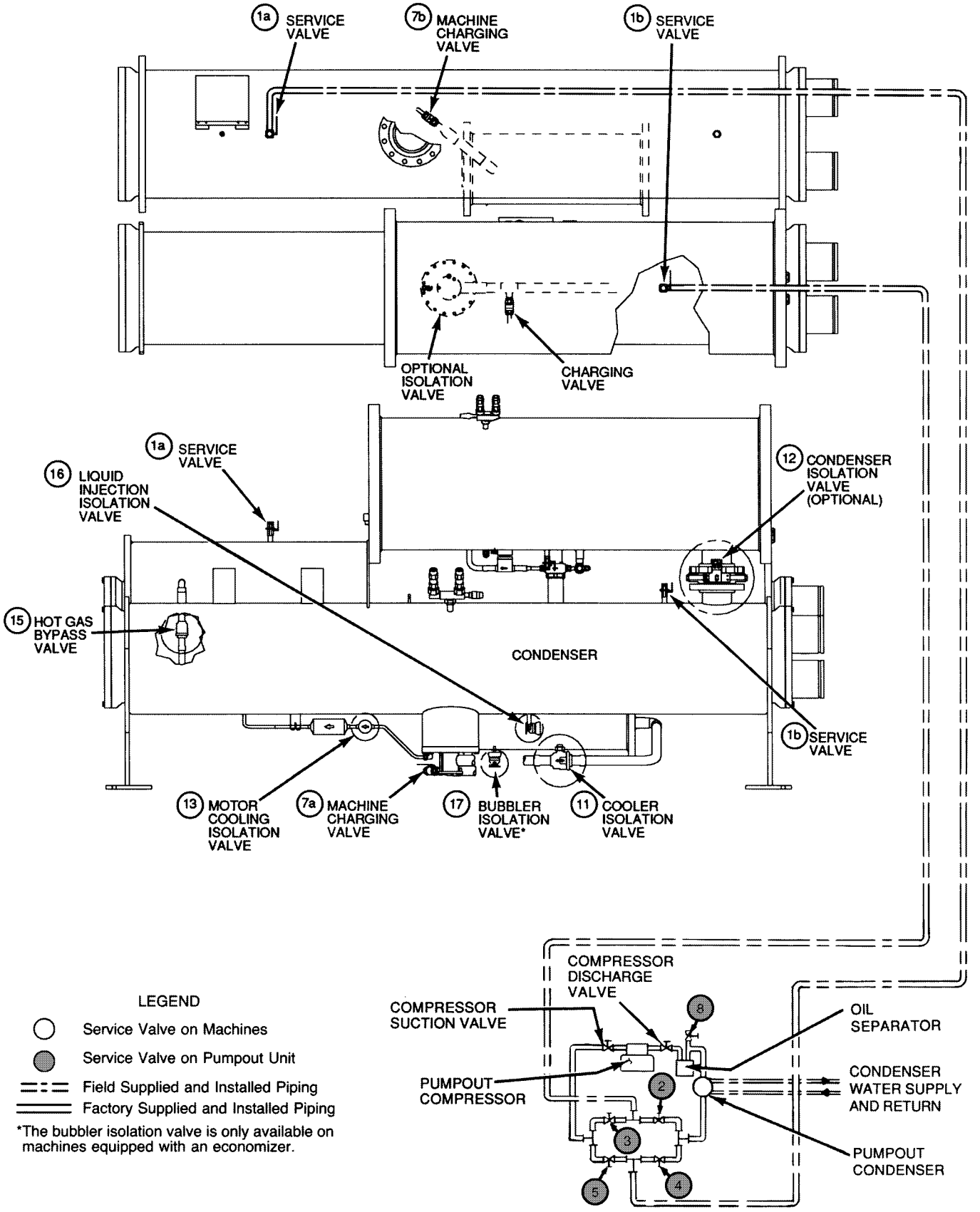


Fig. 34 — Typical Optional Pumpout System Piping Schematic Without Storage Tank (Frame 4 Machines)

Table 6A — HCFC-22 Pressure — Temperature (F)

TEMPERATURE (F)	PRESSURE (psi)	
	Absolute	Gage
-50	11.67	6.154*
-48	12.34	4.829*
-46	13.00	3.445*
-44	13.71	2.002*
-42	14.45	0.498*
-40	15.22	0.526
-38	16.02	1.328
36	16.86	2.163
-34	17.73	3.032
-32	18.63	3.937
-30	19.57	4.877
-28	20.55	5.853
-26	21.56	6.868
-24	22.62	7.921
-22	23.71	9.015
-20	24.85	10.15
-18	26.02	11.32
-16	27.24	12.54
-14	28.50	13.81
-12	29.81	15.11
-10	31.16	16.47
- 8	32.56	17.87
- 6	34.01	19.32
- 4	35.51	20.81
- 2	37.06	22.36
0	38.66	23.96
2	40.31	25.61
4	42.01	27.32
6	43.78	29.08
8	45.59	30.90
10	47.46	32.77
12	49.40	34.70
14	51.39	36.69
16	53.44	38.74
18	55.55	40.86
20	57.73	43.03
22	59.97	45.27
24	62.27	47.58
26	64.64	49.95
28	67.08	52.39

TEMPERATURE (F)	PRESSURE (psi)	
	Absolute	Gage
30	69.59	54.90
32	72.17	57.47
34	74.82	60.12
36	77.54	62.84
38	80.34	65.64
40	83.21	68.51
42	86.15	71.46
44	89.18	74.48
46	92.28	77.58
48	95.46	80.77
50	98.73	84.03
52	102.07	87.38
54	105.50	90.81
56	109.02	94.32
58	112.62	97.93
60	116.31	101.62
62	120.09	105.39
64	123.96	109.26
66	127.92	113.22
68	131.97	117.28
70	136.12	121.43
72	140.37	125.67
74	144.71	130.01
76	149.15	134.45
78	153.69	138.99
80	158.33	143.63
82	163.07	148.37
84	167.92	153.22
86	172.87	158.17
88	177.93	163.23
90	183.09	168.40
92	188.37	173.67
94	193.76	179.06
96	199.26	184.56
98	204.87	190.18
100	210.60	195.91
102	216.45	201.76
104	222.42	207.72
106	228.50	213.81
108	234.71	220.02

TEMPERATURE (F)	PRESSURE (psi)	
	Absolute	Gage
110	241.04	226.35
112	247.50	232.80
114	254.08	239.38
116	260.79	246.10
118	267.63	252.94
120	274.60	259.91
122	281.71	267.01
124	288.95	274.25
126	296.33	281.63
128	303.84	289.14
130	311.50	296.80
132	319.29	304.60
134	327.23	312.54
136	335.32	320.63
138	343.56	328.86
140	351.94	337.25
142	360.48	345.79
144	369.17	354.48
146	378.02	363.32
148	387.03	372.33
150	396.19	381.50
152	405.52	390.83
154	415.02	400.32
156	424.68	409.99
158	434.52	419.82
160	444.53	420.83

*Inches of mercury below one atmosphere.

Table 6B — HCFC-22 Pressure — Temperature (C)

TEMPERATURE (C)	PRESSURE (kPa)	
	Absolute	Gage
-18	264	163
-17	274	173
-16	284	183
-15	296	195
-14	307	206
-13	318	217
-12	330	229
-11	342	241
-10	354	253
- 9	367	266
- 8	380	279
- 7	393	292
- 6	407	306
- 5	421	320
- 4	436	335
- 3	451	350
- 2	466	365
- 1	482	381
0	498	397
1	514	413
2	531	430
3	548	447
4	566	465
5	584	483
6	602	501
7	621	520
8	641	540
9	660	559
10	681	580

TEMPERATURE (C)	PRESSURE (kPa)	
	Absolute	Gage
11	701	600
12	723	622
13	744	643
14	766	665
15	789	688
16	812	711
17	836	735
18	860	759
19	885	784
20	910	809
21	936	835
22	962	861
23	989	888
24	1020	919
25	1040	939
26	1070	969
27	1100	1000
28	1130	1030
29	1160	1060
30	1190	1090
31	1220	1120
32	1260	1160
33	1290	1190
34	1320	1220
35	1360	1260
36	1390	1290
37	1420	1320
38	1460	1360
39	1500	1400
40	1530	1430

TEMPERATURE (C)	PRESSURE (kPa)	
	Absolute	Gage
41	1570	1470
42	1610	1510
43	1650	1550
44	1690	1590
45	1730	1630
46	1770	1670
47	1810	1710
48	1850	1750
49	1900	1800
50	1940	1840
51	1980	1890
52	2030	1930
53	2080	1980
54	2130	2030
55	2170	2070
56	2220	2120
57	2270	2170
58	2320	2220
59	2370	2270
60	2430	2330
61	2480	2380
62	2530	2430
63	2590	2490
64	2640	2540
65	2700	2600
66	2760	2660
67	2820	2720
68	2870	2770
69	2930	2830
70	3000	2900

Table 6C — HFC-134a Pressure — Temperature (F)

TEMPERATURE, F	PRESSURE (psig)
0	6.50
2	7.52
4	8.60
6	9.66
8	10.79
10	11.96
12	13.17
14	14.42
16	15.72
18	17.06
20	18.45
22	19.88
24	21.37
26	22.90
28	24.48
30	26.11
32	27.80
34	29.53
36	31.32
38	33.17
40	35.08
42	37.04
44	39.06
46	41.14
48	43.28
50	45.48
52	47.74
54	50.07
56	52.47
58	54.93
60	57.46
62	60.06
64	62.73
66	65.47
68	68.29
70	71.18
72	74.14
74	77.18
76	80.30
78	83.49
80	86.17
82	90.13
84	93.57
86	97.09
88	100.70
90	104.40
92	108.18
94	112.06
96	116.02
98	120.08
100	124.23
102	128.47
104	132.81
106	137.25
108	141.79
110	146.43
112	151.17
114	156.01
116	160.96
118	166.01
120	171.17
122	176.45
124	181.83
126	187.32
128	192.93
130	198.66
132	204.50
134	210.47
136	216.55
138	222.76
140	229.09

Table 6D — HFC-134a Pressure — Temperature (C)

TEMPERATURE, C	PRESSURE (kPa)
-18.0	44.8
-16.7	51.9
-15.6	59.3
-14.4	66.6
-13.3	74.4
-12.2	82.5
-11.1	90.8
-10.0	99.4
-8.9	108.0
-7.8	118.0
-6.7	127.0
-5.6	137.0
-4.4	147.0
-3.3	158.0
-2.2	169.0
-1.1	180.0
0.0	192.0
1.1	204.0
2.2	216.0
3.3	229.0
4.4	242.0
5.0	248.0
5.6	255.0
6.1	261.0
6.7	269.0
7.2	276.0
7.8	284.0
8.3	290.0
8.9	298.0
9.4	305.0
10.0	314.0
11.1	329.0
12.2	345.0
13.3	362.0
14.4	379.0
15.6	396.0
16.7	414.0
17.8	433.0
18.9	451.0
20.0	471.0
21.1	491.0
22.2	511.0
23.3	532.0
24.4	554.0
25.6	576.0
26.7	598.0
27.8	621.0
28.9	645.0
30.0	669.0
31.1	694.0
32.2	720.0
33.3	746.0
34.4	773.0
35.6	800.0
36.7	828.0
37.8	857.0
38.9	886.0
40.0	916.0
41.1	946.0
42.2	978.0
43.3	1010.0
44.4	1042.0
45.6	1076.0
46.7	1110.0
47.8	1145.0
48.9	1180.0
50.0	1217.0
51.1	1254.0
52.2	1292.0
53.3	1330.0
54.4	1370.0
55.6	1410.0
56.7	1451.0
57.8	1493.0
58.9	1536.0
60.0	1580.0

Standing Vacuum Test — When performing the standing vacuum test or machine dehydration, use a manometer or a wet bulb indicator. Dial gages cannot indicate the small amount of leakage acceptable during a short period of time.

1. Attach an absolute pressure manometer or wet bulb indicator to the machine.
2. Evacuate the vessel using a vacuum pump or the pumpout unit (see Pumpout and Refrigerant Transfer Procedures section on page 61) to the pressure level specified by the EPA under 40 CFR Part 82.
3. Valve off the pump to hold the vacuum and record the manometer or indicator reading.
4. a. If the leakage rate is less than 0.05 in. Hg (.17 kPa) in 24 hours, the machine is sufficiently tight.
   b. If the leakage rate exceeds 0.05 in. Hg (.17 kPa) in 24 hours, repressurize the vessel and test for leaks. If refrigerant is available in the other vessel, pressurize by following Steps 2 - 10 of Return Refrigerant To Normal Operating Conditions section, on page 63. If not, use nitrogen and a refrigerant tracer. Raise the vessel pressure in increments until the leak is detected. If refrigerant is used, the maximum gas pressure is approximately 120 psig (827 kPa) [70 psig (483 kPa)] at normal ambient temperature. If nitrogen is used, limit the leak test pressure to 230 psig (1585 kPa) maximum.
5. Repair leak, retest, and proceed with dehydration.

Machine Dehydration — Dehydration is recommended if the machine has been open for a considerable period of time, if the machine is known to contain moisture, or if there has been a complete loss of machine holding charge or refrigerant pressure.

⚠ WARNING

Do not start or megohm test the compressor motor if the machine is under dehydration vacuum. Insulation breakdown and severe damage may result.

Dehydration is readily accomplished at room temperatures. Use of a cold trap (Fig. 35) may substantially reduce the time required to complete the dehydration. The higher the room temperature, the faster dehydration takes place. At low room temperatures, a very deep vacuum is required for boiling off any moisture. If low ambient temperatures are involved, contact a qualified service representative for the dehydration techniques required.

Perform dehydration as follows:

1. Connect a high capacity vacuum pump (5 cfm [.002 m^3/s] or larger is recommended) to the refrigerant charging valve (Fig. 2A and 2B). Tubing from the pump to the machine should be as short and as large a diameter as possible to provide least resistance to gas flow.
2. Use an absolute pressure manometer or a wet bulb vacuum indicator to measure the vacuum. Open the shutoff valve to the vacuum indicator only when taking a reading. Leave the valve open for 3 minutes to allow the indicator vacuum to equalize with the machine vacuum.
3. Open all isolation valves, if present, if the entire machine is to be dehydrated.
4. With the machine ambient temperature at 60 F (15.6 C) or higher, operate the vacuum pump until the manometer reads 29.8 in. Hg (.7 kPa absolute), ref 30 in. bar, or a vacuum indicator reads 35 F (1.7 C). Operate the pump an additional 2 hours. Do not apply greater vacuum than 29.82 in. Hg vac (.4 kPa absolute) or go below 33 F (.56 C) on the wet bulb vacuum indicator. At this temperature/pressure, isolated pockets of moisture can turn into ice. The slow rate of evaporation (sublimination) of ice at these low temperatures/pressures greatly increases dehydration time.
5. Valve off the vacuum pump, stop the pump, and record the instrument reading.
6. After a 2-hour wait, take another instrument reading. If the reading has not changed, dehydration is complete. If the reading indicates vacuum loss, repeat Steps 4 and 5.
7. If the reading continues to change after several attempts, perform a leak test up to the maximum 230 psig (1585 kPa) pressure. Locate and repair the leak, and repeat dehydration.

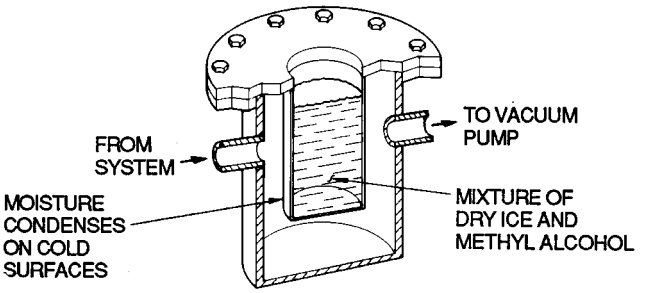


Fig. 35 — Dehydration Cold Trap

Inspect Water Piping — Refer to piping diagrams provided in the certified drawings, and the piping instructions in the 23XL Installation Instructions manual. Inspect the piping to the cooler and condenser. Be sure that flow directions are correct and that all piping specifications have been met.

Piping systems must be properly vented, with no stress on water box nozzles and covers. Water flows through the cooler and condenser must meet job requirements. Measure the pressure drop across cooler and across condenser.

⚠ CAUTION

Water must be within design limits, clean, and treated to ensure proper machine performance and reduce the potential of tubing damage due to corrosion, scaling, or erosion. Carrier assumes no responsibility for chiller damage resulting from untreated or improperly treated water.

Check Optional Pumpout Compressor Water Piping — If the optional storage tank and/or pumpout system are installed, check to ensure the pumpout condenser water has been piped in. Check for field-supplied shutoff valves and controls as specified in the job data. Check for refrigerant leaks on field-installed piping. Refer to the Pumpout and Refrigerant Transfer Procedures section on page 61.

Check Relief Devices — Be sure that relief devices have been piped to the outdoors in compliance with the latest edition of ANSI/ASHRAE Standard 15 and applicable local safety codes. Piping connections must allow for access to the valve mechanism for periodic inspection and leak testing.

Inspect Wiring

⚠ CAUTION

Do not apply any kind of test voltage if the machine is under a dehydration vacuum. Insulation breakdown and serious damage may result.

1. Examine wiring for conformance to job wiring diagrams and to all applicable electrical codes.
2. Connect voltmeter across the power wires to the compressor starter and measure the voltage. Compare this reading with the voltage rating on the compressor and starter nameplates.
3. Compare the ampere rating on the starter nameplate with the compressor nameplate. The overload trip amps must be 108% to 120% of the rated load amps.
4. The starter for a screw compressor motor must contain the components and terminals required for PIC refrigeration control. Check certified drawings.
5. Check the voltage to the pumpout compressor starter and power panel and compare to the nameplate values.
6. Be sure that fused disconnects or circuit breakers have been supplied for the power panel and pumpout unit.
7. Check that all electrical equipment and controls are properly grounded in accordance with job drawings, certified drawings, and all applicable electrical codes.
8. Make sure that the customer's contractor has verified proper operation of the pumps, cooling tower fans, and associated auxiliary equipment. This includes ensuring that motors are properly lubricated and have proper electrical supply and proper rotation.
9. For field-installed starters only, test the machine compressor motor and its power lead insulation resistance with a 500-v insulation tester such as a megohmmeter. Factory-mounted starters do not require a megohm test.
   a. Open the starter main disconnect switch and follow lockout/tagout rules.

⚠ CAUTION

If the motor starter is a solid-state starter, the motor leads must be disconnected from the starter before an insulation test is performed. The voltage generated from the tester can damage the starter's solid-state components.

   b. With the tester connected to the motor leads, take 10-second and 60-second megohm readings as follows:

      6-Lead Motor — Tie all 6 leads together and test between the lead group and ground. Next tie leads in pairs, 1 and 4, 2 and 5, and 3 and 6. Test between each pair while grounding the third pair.

      3-Lead Motor — Tie terminals 1, 2, and 3 together and test between the group and ground.

   c. Divide the 60-second resistance reading by the 10-second reading. The ratio, or polarization index, must be one or higher. Both the 10- and 60-second readings must be at least 50 megohms.

      If the readings on a field-installed starter are unsatisfactory, repeat the test at the motor with the power leads disconnected. Satisfactory readings in this second test indicate the fault is in the power leads.

      NOTE: Unit-mounted starters do not have to be megohm tested.
10. Tighten up all wiring connections to the plugs on the SMM, 8-input, and PSIO modules.
11. Ensure that the voltage selector switch inside the power panel is switched to the incoming voltage rating.
12. On machines with free-standing starters, inspect the power panel to ensure that the contractor has fed the wires into the bottom of the panel. Wiring into the top of the panel can cause debris to fall into the contactors. Clean and inspect the contactors if this has occurred.

Carrier Comfort Network Interface — The Carrier Comfort Network (CCN) communication bus wiring is supplied and installed by the electrical contractor. It consists of shielded, 3-conductor cable with drain wire.

The system elements are connected to the communication bus in a daisy chain arrangement. The positive pin of each system element communication connector must be wired to the positive pins of the system element on either side of it; the negative pins must be wired to the negative pins; the signal ground pins must be wired to signal ground pins.

To attach the CCN communication bus wiring, refer to the certified prints and wiring diagrams. The wire is inserted into the CCN communications plug (COMM1) on the PSIO module. This plug also is referred to as J5.

NOTE: Conductors and drain wire must be 20 AWG (American Wire Gage) minimum stranded, tinned copper. Individual conductors must be insulated with PVC, PVC/nylon, vinyl, Teflon, or polyethylene. An aluminum/polyester 100% foil shield and an outer jacket of PVC, PVC/nylon, chrome vinyl or Teflon with a minimum operating temperature range of −20 C to 60 C is required. See table below for cables that meet the requirements.

MANUFACTURER	CABLE NO.
Alpha	2413 or 5463
American	A22503
Belden	8772
Columbia	02525

When connecting the CCN communication bus to a system element, a color code system for the entire network is recommended to simplify installation and checkout. The following color code is recommended:

SIGNAL TYPE	CCN BUS CONDUCTOR INSULATION COLOR	PSIO MODULE COMM 1 PLUG (J5) PIN NO.
+	RED	1
Ground	WHITE	2
-	BLACK	3

Check Starter

⚠ CAUTION

BE AWARE that certain automatic start arrangements *can engage the starter*. Open the disconnect *ahead* of the starter in addition to shutting off the machine or pump.

Use the instruction and service manual supplied by the starter manufacturer to verify that the starter has been installed correctly.

⚠ CAUTION

The main disconnect on the starter front panel may not deenergize all internal circuits. Open all internal and remote disconnects before servicing the starter.

When a starter safety trip device activates, wait at least 30 seconds before resetting the safety. The microprocessor maintains its output to the 1CR relay for 10 seconds to determine the fault mode of failure.

MECHANICAL-TYPE STARTERS

1. Check all field wiring connections for tightness, clearance from moving parts, and correct connection.
2. Check the contactor(s) to be sure they move freely. Check the mechanical interlock between contactors to ensure that 1S and 2M contactors cannot be closed at the same time. Check all other electro-mechanical devices, e.g., relays, timers, for free movement. If the devices do not move freely, contact the starter manufacturer for replacement components.
3. Some dashpot-type magnetic overload relays must be filled with oil on the job site. If the starter is equipped with devices of this type, remove the fluid cups from these magnetic overload relays. Add dashpot oil to cups per instructions supplied with the starter. The oil is usually shipped in a small container attached to the starter frame near the relays. Use only dashpot oil supplied with the starter. Do not substitute.

   Factory-filled dashpot overload relays need no oil at start-up and solid-state overload relays do not have oil.
4. Reapply starter control power *(not main chiller power*) to check electrical functions. When using a reduced-voltage starter (such as a wye-delta type) check the transition timer for proper setting. The factory setting is 5 seconds (±1 second), timed closing. The timer is adjustable in a range from 0.1 to 30 seconds and settings other than the nominal 5 seconds may be chosen as needed (typically 3 to 30 seconds are used).

   When the timer has been set, check that the starter, with relay 1CR closed, goes through a complete and proper start cycle.

BENSHAW, INC. SOLID-STATE STARTERS

⚠ WARNING

This equipment is at line voltage when AC power is connected. Pressing the STOP button does not remove voltage. Use caution when adjusting the potentiometers on the equipment.

1. Check that all wiring connections are properly terminated to the starter.
2. Verify that the ground wire to the starter is installed properly and is of sufficient size.
3. Verify that the motors are properly grounded to the starter.
4. Check that all of the relays are properly seated in their sockets.
5. Verify that the proper ac input voltage is brought into the starter per the certified drawings.
6. Verify the initial factory settings of the starting torque and ramp potentiometers are set per the note on the schematic for the starters.

   NOTE: The potentiometers are located at the lower left hand corner on the circuit board mounted in front of the starter power stack (Fig. 36 and 37). The board is turned on its side so that the 9:00 o'clock position is located where the 6:00 o'clock position would normally be located.

   The starting torque potentiometer should be set so that when the PIC calls for the motor to start, the rotor should start to turn. The nominal dial position for a 60 Hz motor is approximately in the 11:30 position. The dial position for 50 Hz motors is approximately in the 9:30 position when the board is turned on its side so that the 9:00 o'clock position is located where the 6:00 o'clock position would normally be located. The ramp potentiometer should be set that so the motor is up to full speed in 8 to 10 seconds, the bypass contactors have energized, and the auxiliary LCD is energized.
7. Proceed to apply power to the starter.
8. The Power +15 and Phase Correct LEDs should be on. If not, see the Troubleshooting Guide, Solid-State Starter section.

Oil Charge — If oil is added, it must meet Carrier's specification for screw compressor usage as described in the Changing Oil and Oil Filter section on page 64. Charge the oil through the oil charging valve. The oil must be pumped from the oil container through the charging valve due to higher refrigerant pressure. The pumping device must be able to lift from 0 to 200 psig (0 to 1380 kPa) or above unit pressure. Oil should only be charged or removed when the machine is shut down.

⚠ WARNING

All oil filter isolation valves should always be left open, except when changing the oil, or oil filter as defined in the Changing Oil and Oil Filter section, page 64.

Power Up the Controls and Check the Oil Heater

NOTE: Frame 1 and 2 machines include an oil heater. Frame 4 machines do not use an oil heater.

Ensure that an oil level is visible in the oil sump section before energizing controls. A circuit breaker in the starter energizes the oil heater and the control circuit. When first powered, the LID should display the default screen within a short period of time.

The oil heater is energized by powering the control circuit. This should be done several hours before start-up to minimize oil-refrigerant migration. The oil heater is controlled by the PIC and is powered through a contactor in the power panel. Starters contain a separate circuit breaker to power the heater and the control circuit. This set up allows the heater to energize when the main motor circuit breaker is off for service work or extended shutdowns. The oil heater relay status can be viewed on the Status02 table on the LID. Oil sump temperature can be viewed on the LID default screen. Minimum oil sump temperature set point when the compressor is shut down is 140 F (60 C).

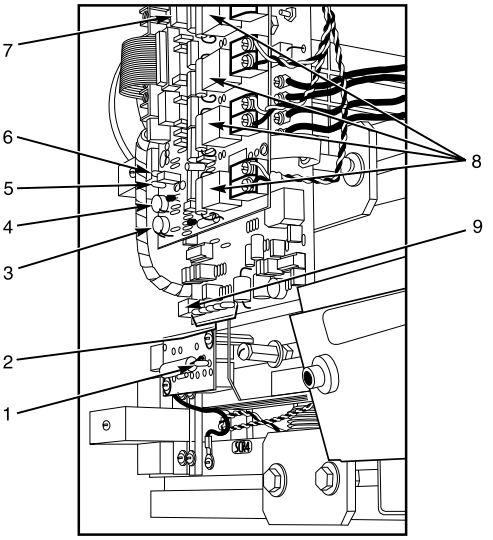
NOTE: The PSIO software version will always be labelled on the PSIO module and on the back of the LID module. The PSIO software version number will also appear on both the Controller ID and LID ID display screens.

Set Up Machine Control Configuration

⚠ WARNING

Do not operate the machine before the control configurations have been checked and a control test has been satisfactorily completed. Protection by safety controls cannot be assumed until all control configurations have been confirmed.

As configuration of the 23XL machine is performed, write down all configuration settings. A log, such as the one shown on pages CL-1 to CL-12, provides a convenient list for configuration values.

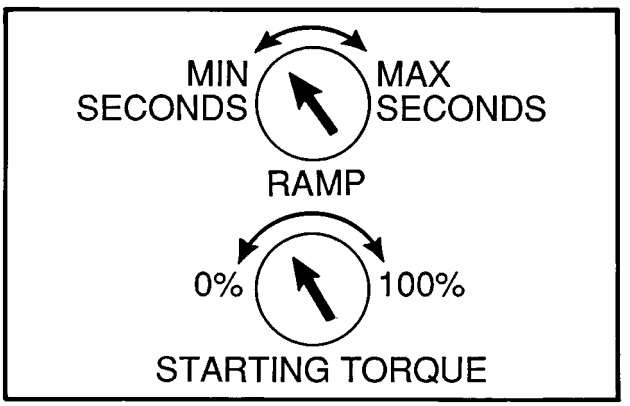


LEGEND

1 — Phase Voltage Indicator
2 — Starter Fault and Run LEDs (5)
- Overtemp
- Ground Fault
- Current Unbalance (CUB) While Stopped
- Current Unbalance
- Run (Start Initiated)

3 — Starting Torque Potentiometer
4 — Ramp Up Potentiometer
5 — Phase Correct LED
6 — Relay On LED
7 — Power +15 and Auxiliary (Starter in RUN State) LEDs (Hidden)
8 — SCR Indicator LEDs (Hidden)
9 — Reset Button

Fig. 36 — Typical Benshaw, Inc. Solid-State Starter Power Stack



NOTE: Adjustments:
Starting torque — 0% to 100% rated motor torque.
Ramp time to full motor voltage — 0.5 seconds to 60 seconds.

Fig. 37 — Ramp Up and Starting Torque Potentiometers

⚠ WARNING

This equipment is at line voltage when ac power is connected. Pressing the STOP button does not remove voltage. Use caution when adjusting the potentiometers on the equipment.

1. Check that all wiring connections are properly terminated to the starter.
2. Verify that the ground wire to the starter is installed properly and is of sufficient size.
3. Verify that the motor is properly grounded to the starter.
4. Check that all of the relays are properly seated in their sockets.
5. Verify that the proper ac input voltage is brought into the starter. Refer to the certified drawings.

The order in which the solid-state control module adjustment potentiometers are set is important because of the interdependency of these functions. See Table 7 and Fig. 38. The settings should be made in the following sequence:

Potentiometer Adjustment

NOTE: All potentiometers are factory set. The following information is provided for reference.

Adjustment potentiometers are nearly linear. To make an initial setting, determine the percentage of the potentiometer rotation. Use the following formula to calculate the percent of rotation. See Fig. 38 and 39.

$$\% \text{ of rotation} = \frac{(\text{desired setting}) - (\text{minimum setting})}{(\text{maximum setting}) - (\text{minimum setting})}$$

Example: Starting current is adjustable between 100% and 400% of motor full load current. The initial setting for 200% starting current is as follows:

$$\% \text{ of rotation} = \frac{(200\%) - (100\%)}{(400\%) - (100\%)} = \frac{1}{3} \text{ of full rotation } (33\%)$$

⚠ CAUTION

Do not adjust any potentiometer beyond its stops. This type of adjustment will result in damage to the potentiometer.

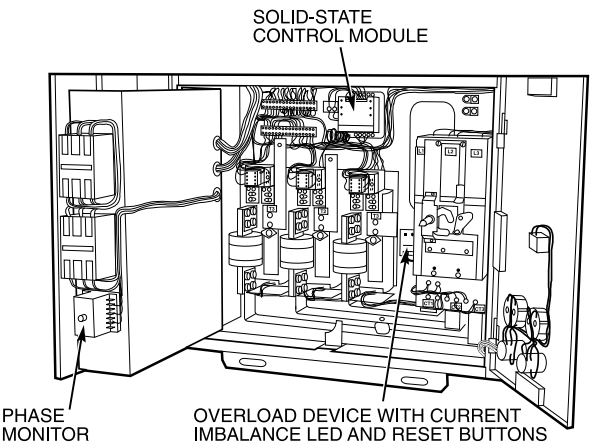


Fig. 38 — Typical Cutler-Hammer Solid-State Starters

Table 7 — Potentiometer Adjustment

DIAL	ADJUSTMENT RANGE		FUNCTION	FACTORY SETTING
	Minimum (CCW)	Maximum (CW)		
Starting Current	100%	400%	Sets initial starting current level.	100%
Ramp Time (Adjustable Current Ramp)	2 seconds	30 seconds	Sets time during which current ramps from the initial starting level to the maximum possible current limit setting.	10 seconds
Current Limit	100%	400%	Sets maximum starting current.	250%
Pulse Start	0 (Off)	2 seconds	Sets duration of 400% current pulse. Pulse is used to break load free.	OFF
Current Trip	50%	400%	Sets running current trip.	175%
Power Saver	—	—	—	OFF

CCW — Counterclockwise
CW — Clockwise

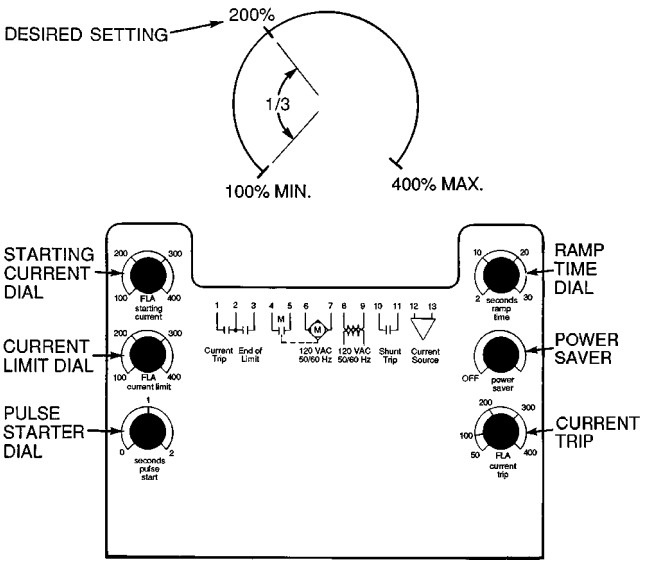


Fig. 39 — Typical Potentiometer Adjustment

Starting Current — The torque required to start a machine (initial torque) varies from one application to another. Starting current may be adjusted to match the initial motor torque of the application. The starting current value is adjustable from 100% to 400% FLA and is factory set at 100%. If quick acceleration is desired, set the starting current at a higher level.

Ramp Time (Adjustable Current Ramp) — The motor current is ramped up from the starting current value over a timed period set by the ramp time potentiometer (adjustable from 2 to 30 seconds at 400% current limit setting). The 23XL is factory set at 10 seconds. However, based on jobsite conditions, a range of ±5 seconds is acceptable.

Current Limit — This protection limits motor current to a set value and holds motor torque at a reduced level during motor start. The current limit is adjustable from 100% to 400% of the motor full load current value. The current limit is factory set at 250%.

Pulse Start — A pulse start is not used on this machine. It is set to the OFF position.

Current Trip — A control contact closes when the motor reaches a factory set value of 175% of full load amps. This signal is used as an interlock to shut down the machine if the motor stalls (increasing load).

Changing Adjustments — The settings are interdependent. If any setting is changed, the other settings should be checked. Check the settings in the sequence shown above.

Voltage Measurements — Consider the following when checking voltage measurements:

- Before energizing the starter, check the incoming lines for properly balanced voltages.
- Close the circuit breaker to apply power to the starter. Verify the 120 vac control voltage.
- Visually check to ensure that all fans are running (if applicable).
- Verify phase sequence at line terminals. Incorrect phase sequence will result in a shunt trip of the circuit breaker.
- Verify that the phase rotation of the lines to the motor is correct.
- If the motor is found to be rotating in the wrong direction, interchange any two phases to the motor.
- Start the unit.
- When unit reaches full speed, monitor the running current to ensure that the motor is not overloaded.

High Altitude Locations — Recalibration of the pressure transducers will be necessary since the machine was initially calibrated at sea level. Please see the calibration procedure in the Troubleshooting Guide section on page 68.

Input the Design Set Points — Access the LID Set Point menu and view/modify the Base Demand Limit set point and *either* the LCW set point, the ECW set point, or Ice Build set point. The PIC can control a set point to either the leaving or entering chilled water. This control method is set in the Equipment Configuration menu Config table. See Fig. 21.

Input the Local Occupied Schedule (OCCPC01S) — Access the schedule OCCPC01S screen on the LID and set up the occupied time schedule per the customer's requirements. If no schedule is available, set it for 24 hours occupied days per week including holidays. This is also the default setting of the schedule. For this schedule, modify Period 1 for ON at 0000 and OFF at 2400 and enable the period to be in effect for all days and holidays. For more information about how to set up a time schedule, read the Controls section, page 13.

The CCN Occupied Schedule (OCCPC03S) should be configured if a CCN system is being installed or if a secondary time schedule is required. It normally is input through the CCN Building Supervisor, but it can also be modified at the LID.

Selecting Refrigerant Type — The 23XL control must be configured for the refrigerant being used, either HCFC-22 or HFC-134a.

TO CONFIRM REFRIGERANT TYPE — Confirm that the correct refrigerant type is indicated by entering the Service menu and selecting Control Test. See Fig. 21. Select Refrigerant Type. The screen will display the current refrigerant setting. Press EXIT softkey to leave the screen without changes.

TO CHANGE REFRIGERANT TYPE — Enter the Service menu and select Control Test. See Fig. 21. Select Refrigerant Type. The screen will display the current refrigerant setting. Press the YES softkey to change the current setting. Next, move to the Attach To Network Device menu and select ATTACH TO LOCAL DEVICE to upload the new refrigerant tables.

Input Service Configurations — The following configurations require the LID screen to be in the Service portion of the menu.

- password
- input time and date
- LID configuration
- controller identification
- service parameters
- equipment configuration
- automated controls test

PASSWORD — When accessing the Service screens, a password must be entered. All LIDs are initially set for a password of 1-1-1-1. This password may be changed in the LID configuration screen, if desired. See Fig. 21.

INPUT TIME AND DATE — Access the Time and Date menu on the Service menu. Input the present time of day, date, and day of the week. ''Holiday Today'' should only be configured to ''Yes'' if the present day is considered a one-time holiday. This causes the chiller to start and stop as depicted by the holiday configuration under the appropriate time schedule screen.

CHANGE LID CONFIGURATION IF NECESSARY — The LID Configuration on the service menu is used to view or modify the LID CCN address, change to English or SI units and to change the password. If there is more than one machine at the jobsite, change the LID address on each machine so that each machine has its own address. Note and record the new address. Change to SI units, as required, and change the password, if desired.

MODIFY CONTROLLER IDENTIFICATION, IF NECESSARY — The controller identification screen is used to change the PSIO module address. Change this address for each machine if there is more than one machine at the jobsite. Write the new address on the PSIO module for future reference.

Change the LID address if there is more than one machine on the jobsite. Access the LID configuration screen to view or modify this address.

INPUT EQUIPMENT SERVICE PARAMETERS AS NECESSARY — The Equipment Service table has three service tables: Service1, Service2, and Service3.

Configure Service1 Table — Access Service1 table to modify/view the following to jobsite parameters:

Chilled Medium	Water or Brine
Brine Refrigerant Trip Point	Usually 3° F (1.7° C) below design refrigerant temperature
Hot Gas Bypass Option	Is HGBP installed?
Minimum Load Points (T1/P1)	Per job data — See Modify Load Points section
Maximum Load Points (T2/P2)	Per job data — See Modify Load Points section
Motor Rated Load Amps	Per job data
Motor Rated Line Voltage	Per job data
Motor Rated Line KW	Per job data
Line Frequency	50 or 60 Hz (if optional kW transducer installed)
Compressor Starter Type	Reduced voltage or full voltage

NOTE: Other values are left at the default values. These may be changed by the operator as required. Service2 and Service3 tables can be modified by the owner/operator, as required.

Modify Minimum and Maximum Load Points (ΔT1/P1; Δ T2/P2) —The pairs of machine load points, located on the Service1 table, determine when to open the hot gas bypass solenoid valve. The points should be set based on individual machine operating conditions.

Close the ball valve, located next to the hot gas solenoid valve, halfway. The purpose of the ball valve is to act as an isolation valve and to control the amount of gas flow by adjusting the flow to accommodate different frame sizes and jobsite conditions.

If, after setting the ball valve for these points, any additional adjustment should be changed by the operator.

Example of configuration: Machine operating parameters

Estimated Minimum Load Conditions:

44 F (6.7 C) LCW
46.5 F (8.1 C) ECW
43 F (6.1 C) Suction Temperature
70 F (21.1 C) Condensing Temperature

Estimated Maximum Load Conditions:

44 F (6.7 C) LCW
54 F (12.2 C) ECW
42 F (5.6 C) Suction Temperature
98 F (36.7 C) Condensing Temperature

Calculate Maximum Load — To calculate maximum load points, use design load condition data.

Maximum Load ΔT2:

54 - 44 = 10 F (12.2 - 6.7 = 5.5 C)

Maximum Load ΔP2:

(Factory Recommended Setting)
200 psi (1379 kPa)[125 psi (862 kPa)]

Calculate Minimum Load — To calculate minimum load conditions, estimate the temperature difference that the cooler will have at 25% load or lower, then estimate what the suction and condensing temperatures will be at this point.

Suction Temperature:

43 F (6.1 C) = 73 psig (503 kPa) saturated refrigerant pressure

Condensing Temperature:

70 F (21.1 C) = 121 psig (834 kPa) saturated refrigerant pressure

Minimum Load ΔT1:
46.5 −44 = 2.5 F (8.1 −6.7 = 1.4 C)

Minimum Load ΔP1:
121 − 73 = 45 psid (834 - 503 = 331 kPad)

To avoid unnecessary opening of the hot gas bypass valve, add 5 psi (35 kPa) at ΔP1 from these conditions:
ΔT1 = 2.5 F (1.4 C)
ΔP1 = 50 psid (345 kPad) [30 psid (207 kPad)]

If opening of the hot gas bypass valve occurs too soon or too late for the present conditions these parameters should be changed by the operator. Only the minimum load points change is required.

Energizing the hot gas bypass solenoid valve with the ball valve fully open and the cold condenser water at a very low temperature will result in the equalization of evaporator and condenser pressure. This will result in a ''Low Oil Pressure'' alarm. See the Lubrication Cycle section on page 7.

MODIFY EQUIPMENT CONFIGURATION AS NECESSARY — The Equipment Configuration table has tables to select and view or modify. Carrier's certified drawings will have the configuration values required for the jobsite. Modify these tables only if requested.

Config Table Modifications — Change the values in this table per job data. See certified drawings for values. Modifications include:

- chilled water reset
- entering chilled water control (Enable/Disable)
- 4-20 mA demand limit
- auto restart option (Enable/Disable)
- remote contact option (Enable/Disable)

Owner-Modified CCN Tables — The following tables are described for reference only.

Occdefcs Table Modifications — The Occdefcs tables contain the Local and CCN time schedules, which can be modified here, or in the Schedule menu selection as described previously.

Holidef Table Modifications — The Holidef tables configure the days of the year that holidays are in effect. See the holiday paragraphs in the Controls section for more details.

Brodefs Table Modifications — The Brodefs screen defines the outside air temperature sensor and humidity sensor (if installed). It will define the start and end of daylight savings time. Enter the dates for the start and end of daylight savings if required for the location. Brodefs also will activate the Broadcast function which enables the holiday periods that are defined on the LID.

Other Tables — The Alarmdef, Cons-def, and Runt-def contain tables for use with a CCN system. See the applicable CCN manual for more information on these tables. These tables can only be defined through a CCN Building Supervisor.

CHECK VOLTAGE SUPPLY — Access the Status01 table and read the actual line voltage. This reading should be equal to the incoming power to the starter. Use a voltmeter to check incoming power at the starter power leads. If the readings are not equal, an adjustment can be made to the 24-v input to the SMM at a potentiometer located in the low voltage section to equalize the two readings.

PERFORM AN AUTOMATED CONTROL TEST — Check the safety controls status by performing an automated control test. Access the Control Test table and select the Automated Tests function (Table 8).

The automated control test will check all outputs and inputs for function. It will also set the refrigerant type. The compressor must be in the OFF mode in order to operate the controls test and the 24-v input to the SMM must be in range (per line voltage percent on Status01 table). The OFF mode is caused by pressing the STOP pushbutton on the LID located on the left side of the four softkeys). Each test will ask the operator to confirm that the operation is occurring, and whether or not to continue. If an error occurs, the operator has the choice to try to address the problem as the test is being run or to note the problem and proceed to the next test.

When the test is finished, or the EXIT softkey is pressed, the test will be stopped and the Control Test table will be displayed. If a specific automated test procedure is not completed, access that particular controls test to test the function when ready. The Control Test table is described as follows:

Automated Tests	As described above, a complete controls test.
PSIO Thermistors	Check of all PSIO thermistors only.
Option Module Thermistors	Check of all option module thermistors.
Transducers	Check of all transducers.
Slide Valve	Check of the slide valve operation.
Pumps	Check operation of pump outputs, either all pumps can be activated, or individual pumps can be activated. The test will also test the associated input such as flow or pressure.
Discrete Outputs	Activation of all on/off outputs or individual on/off outputs.
Pumpdown	Pumpdown prevents the low refrigerant alarm during evacuation so refrigerant can be removed from the unit. Pumpdown also locks the compressor off and starts the water pumps.
Terminate Lockout	Charges refrigerant and enables the chiller to run after pumpdown lockout.
Refrigerant Type*	Sets type of refrigerant used: HCFC-22 or HFC-134a.

*Make sure to Attach to Local Device after changing refrigerant type. Refer to Selecting Refrigerant Type section on page 53.

Table 8 — Control Test Table Functions

TESTS TO BE PERFORMED	DEVICES TESTED
1. Automated Tests*	Operates the second through seventh tests
2. PSIO Thermistors	Entering chilled water Leaving chilled water Entering condenser water Leaving condenser water Discharge temperature Motor winding temperature Oil sump temperature
3. Option Module Thermistors	Common chilled water supply sensor Common chilled water return sensor Remote reset sensor Temperature sensor — Spare 1 Spare 2 Spare 3 Spare 4 Spare 5 Spare 6 Spare 7 Spare 8 Spare 9
4. Transducers	Evaporator pressure Condenser pressure Oil pressure Oil pressure differential
5. Slide Valve Assembly	Load (Close Unload (Open)
6. Pumps	Either or both pumps may be activated: Chilled water pump — Confirm flow Condenser water pump — Confirm flow
7. Discrete Outputs	All outputs or individual outputs may be energized: Hot gas bypass relay Oil heater relay (Frame 1 and 2 Machines) VI inlet relay Tower fan relay Alarm relay
8. Pumpdown	When using pumpdown lockout, observe freeze-up precautions when removing charge: Instructs operator as to which valves to close and when Starts chilled water and condenser water pumps and confirms flow Monitors — Evaporator pressure Condenser pressure Evaporator temperature during pumpout procedures Turns pumps off after pumpdown Locks out compressor
9. Terminate Lockout	Starts pumps and monitors flows Instructs operator as to which valves to open and when Monitors — Evaporator pressure Condenser pressure Evaporator temperature during charging process Terminates compressor lockout
10. Refrigerant Type†	Sets the refrigerant type used: HCFC-22 or HFC-134a

*During any of the tests that are not automated, an out-of-range reading will have an asterisk (*) next to the reading and a message will be displayed.

†Make sure to Attach to Local Device after changing refrigerant type. Refer to Selecting Refrigerant Type section on page 53. See Fig. 21.

Check Optional Pumpout System Controls and Compressor — Controls include an on/off switch, a 3-amp fuse, the compressor overloads, an internal thermostat, a compressor contactor, and a refrigerant high pressure cutout. The high pressure cutout is factory set to open at 220 ± 5 psig (1250 ± 34 kPa), and automatically reset at 185 +0,-7 (1280 +0,-48 kPa) with HCFC-22. HFC-134a units open at 161 psig (1110 kPa) and reset at 130 psig (896 kPa). Check that the water-cooled condenser has been connected. Loosen the compressor holddown bolts to allow free spring travel. Open the compressor suction and discharge service valves. Check that oil is visible in the compressor sight glass. Add oil if necessary.

See Pumpout and Refrigerant Transfer Procedures and Optional Pumpout System Maintenance sections on pages 61 and 67 for details on transfer of refrigerant, oil specifications, etc.

Charge Refrigerant into Machine

⚠ CAUTION

The transfer, addition, or removal of refrigerant in spring isolated machines may place severe stress on external piping if springs have not been blocked in both up and down directions.

The standard 23XL machine will have the refrigerant already charged in the vessels. The 23XL may be ordered with a nitrogen holding charge of 15 psig (103 kPa). Evacuate the entire machine, and charge machine from refrigerant cylinders.

23XL MACHINE EQUALIZATION WITHOUT PUMPOUT UNIT

⚠ WARNING

When equalizing refrigerant pressure on the 23XL machine after service work or during the initial machine start-up, *do not use the discharge isolation valve to equalize.* The motor cooling isolation valve should be used as the equalization valve.

To equalize the pressure differential on a refrigerant isolated 23XL machine, use the TERMINATE LOCKOUT function of the Control Test from the SERVICE menu. This will help to turn on pumps and advise the proper procedure. The following procedure describes how to equalize refrigerant pressure on an isolated 23XL machine without a pumpout unit:

1. Access TERMINATE LOCKOUT function on the Controls Test.
2. Turn on the chilled water and condenser water pumps to ensure against freezing.
3. Slowly open the motor cooling isolation valve 13. The machine cooler and condenser pressures will gradually equalize. This process will take approximately 15 minutes.
4. Once the pressures have equalized, the condenser isolation valve and cooler isolation valve may be opened. Refer to Fig. 31-34, Valves 11 and 12.

⚠ WARNING

Whenever turning the discharge isolation valve, be sure to re-attach the valve locking device. This will prevent the valve from opening or closing during service work or during machine operation.

The full refrigerant charge on the 23XL will vary with machine components and design conditions, indicated on the job data specifications. An approximate charge may be found in Table 9.

Always operate the condenser and chilled water pumps during charging operations to prevent freeze-ups. Use the Control Test, Terminate Lockout to monitor conditions and start the pumps.

If the machine has been shipped with a holding charge, the refrigerant will be added through the refrigerant charging valve (Fig. 31-34) or to the pumpout charging connection. First evacuate the nitrogen holding charge from the vessels. Charge the refrigerant as a gas until the system pressure exceeds 68 psig (469 kPa) [35 psig (141 kPa)]. After the machine is beyond this pressure, the refrigerant should be charged as a liquid until all of the recommended refrigerant charge has been added.

Table 9 — Refrigerant Charges

COOLER SIZE	ECONOMIZER	REFRIGERANT			
		HCFC-22		HFC-134a	
		lb	kg	lb	kg
10,11	NO	600	272	*	*
	YES	650	295	*	*
20,21	NO	700	318	*	*
	YES	750	340	*	*
40	NO	900	408	800	363
	YES	1000	454	850	386
41	NO	1000	454	850	386
	YES	1100	499	900	408
42	NO	1100	499	900	408
	YES	1200	544	950	431
43	NO	1200	544	950	431
	YES	1300	590	1000	454

*Not available or retrofitable when using HFC-134a.

TRIMMING REFRIGERANT CHARGE — The 23XL is shipped with the correct charge for the design duty of the machine. Trimming the charge can be best accomplished when design load is available. To trim, check the temperature difference between leaving chilled water temperature and cooler refrigerant temperature at full load design conditions. If necessary, add or remove refrigerant to bring the temperature difference to design conditions or minimum differential. *Do not overcharge.*

INITIAL START-UP

Preparation — Before starting the machine, check to ensure that the:

1. Power is on to the main starter, tower fan starter, oil heater relay (Frame 1 and 2 machines), and the machine control center.
2. Cooling tower water is at proper level, above 55 F (12.8 C) but at or below design entering temperature.
3. Machine is charged with refrigerant and all refrigerant and oil valves are in their proper operating position.
4. Oil is at the proper level in the oil sump sight glass.
5. Oil temperature is above cooler or refrigerant temperature plus 35° F (19° C) on Frame 1 and 2 machines only.
6. Valves in the evaporator and condenser water circuits are open.

   NOTE: If pumps are not automatic, make sure water is circulating properly.
7. Solid-state starter checks: The Power +15 and the Phase Correct LEDs must be lit before the starter will energize. If the Power +15 LED is not on, incoming voltage is not present or is incorrect. If the Phase Correct LED is not lit, rotate any 2 incoming phases to correct the phasing.

⚠ WARNING

Do not permit water or brine that is warmer than 110 F (43 C) to flow through the cooler or condenser. Refrigerant overpressure may discharge through the relief devices and result in the loss of refrigerant charge.

8. Press RELEASE to automate the chiller start/stop value on the Status01 table to enable the chiller to start. The initial factory setting of this value is overridden to stop in order to prevent accidental start-up.

Dry Run to Test Start-Up Sequence

1. Disengage the main motor disconnect on the starter front panel. This should only disconnect the motor power. Power to the controls, and starter control circuit should still be energized.
2. Look at the default screen on the LID: the Status message in the upper left-hand corner will show that the machine is in the OCCUPIED mode and is ready to start. If not, go to the Schedule menu and override the schedule or change the occupied time. Press the LOCAL softkey to begin the start-up sequences.
3. Check that chilled water and condenser water pumps energize.
4. After approximately 3 minutes, the starter will be energized and go through its start-up sequence.
5. Check the main contactor for proper operation.
6. The PIC will eventually show an alarm for motor amps not sensed. Reset this alarm and continue with the initial start-up.

Check Rotation

1. Engage the main motor disconnect on the front of the starter panel. The motor is now ready for a rotation check.
2. After the default screen primary Status message states "READY TO START," press the LOCAL softkey. Start-up checks will be made by the control.
3. When the starter is energized and the motor begins to turn over, check the default screen Status messages.

If rotation is not proper, the primary Status message states "FAILURE TO START" and "MOTOR WIRING INCORRECT" is displayed for the secondary Status message. Reverse any 2 of the 3 incoming power leads to the starter and recheck rotation.

If rotation is proper , allow the compressor to come up to speed.

NOTE: Starters may have phase protection and will not allow a start if the phase is not correct. Instead, a ''STARTER FAULT'' message will occur if this happens.

NOTES ON SOLID-STATE STARTERS

1. When the compressor is energized to start by the 1CR relay, confirm that the ''Relay On LED'' is lit on the starter SCR control board. The compressor motor should start to turn immediately when this light comes on. If not, adjust the start torque potentiometer in a clockwise direction.
2. Observe that all 6-gate LEDs are lit on the starter SCR control board.
3. The factory setting should bring the motor to full voltage in 3 to 5 seconds on Wye delta starters or 8 to 10 seconds on solid-state starters. If the setting is not correct, adjust the ramp potentiometer counterclockwise for a shorter time, clockwise for a longer time.

Check Oil Pressure and Compressor Stop

1. Two minutes after start-up, note the oil pressure reading on the LID default screen. The value is equal to the difference between the oil and evaporator pressure transducer readings. The minimum oil pressure is 20-40 psi (138-276 kPa) [7-40 psi (48-276 kPa)]. The oil and evaporator pressure transducer readings can be observed on the Status01 table. A normal full load reading is approximately 120 psi (827 kPa) [78 psi (538 kPa)].
2. Press the STOP softkey and listen for any unusual sounds from the compressor as it coasts to a stop.

Calibrate Motor Current Demand Setting

NOTE: Entering condenser water temperature must equal design for compressor to meet 100% RLA at designs tons.

1. Make sure that the compressor motor rated load amps in the Service1 table has been configured. Place an ammeter on the line that passes through the motor load current transformer on the motor side of the power factor correction capacitors (if provided).
2. Set the chilled water set point to the desired value. Highlight the appropriate chilled water set point on the set point screen then press SELECT. Press INCREASE or DECREASE to bring the value top desired value. Press ENTER when equal.
3. Start the compressor and establish a steady motor current by overriding the Active Demand Limit on the Status01 table. Highlight this point, then press SELECT. Press INCREASE or DECREASE to bring the value between 70% and 100% RLA. Press ENTER when finished.
4. Compare the compressor motor amps value on the Status01 table to the actual amps shown on the ammeter on the starter. Adjust the amps value on the LID to the actual value seen at the starter if there is a difference. Highlight the amps value then press SELECT. Press INCREASE or DECREASE to bring the value to that indicated on the ammeter. Press ENTER when equal. The adjustments should not be performed in intervals of more than 10 amps.
5. Gradually increase the Active Demand Limit and repeat Step 4.
6. When calibration is complete, make sure that the Active Demand Limit is released to PIC control.

To Prevent Accidental Start-Up — The PIC can be set up so that start-up of the unit is more difficult than just pressing the LOCAL or CCN softkeys during machine service or when necessary. By accessing the Status01 table, and highlighting the chiller Start/Stop line, the value can be overridden to stop by pressing SELECT and then the STOP and ENTER softkeys. ''SUPVSR'' will appear after the value. When attempting to restart, remember to release the override. The default machine message line will also state that the Start/Stop has been set to ''Start'' or ''Stop'' when the value is overridden.

Check Machine Operating Conditions — Check to be sure that machine temperatures, pressures, water flows, and oil and refrigerant levels indicate that the system is functioning properly.

Instruct the Operator — Check to be sure that the operator(s) understands all operating and maintenance procedures. Point out the various machine parts and explain their function as part of the complete system.

COOLER-CONDENSER — Float valve, relief devices, refrigerant charging valve, temperature sensor locations, pressure transducer locations, Schrader fittings, waterboxes and tubes, and vents and drains.

OPTIONAL STORAGE TANK AND PUMPOUT SYSTEM — Transfer valves and pumpout system, refrigerant charging and pumpdown procedure, and relief devices.

MOTOR COMPRESSOR ASSEMBLY — Slide valve assembly, motor cooling system, temperature and pressure sensors, motor temperature sensors, and compressor serviceability.

MOTOR COMPRESSOR LUBRICATION SYSTEM — Oil heater (Frame 1 and 2 machines), oil charge and specification, synthetic oil, operating and shutdown oil level, temperature and pressure, and oil charging connections.

COMPRESSOR LUBRICATION SYSTEM — Oil sight glass, operating and shutdown oil level, temperature and pressure transducers, isolatable oil filter assembly, oil charging and drain connections, rotor inlet sensors, discharge pressure transducer, and oil charge and specifications.

OIL SEPARATION SYSTEM — Oil sight glasses, sensors, muffler, and oil level switch (Frame 4 machines only).

CONTROL SYSTEM — CCN and Local start, reset, menu, softkey functions, LID operation, occupancy schedule, set points, safety controls, and auxiliary and optional controls.

AUXILIARY EQUIPMENT — Starters and disconnects, separate electrical sources, pumps, and cooling tower.

DESCRIBE MACHINE CYCLES — Refrigerant, motor cooling, lubrication, and oil reclaim.

REVIEW MAINTENANCE — Scheduled, routine, and extended shutdowns, importance of a log sheet, importance of water treatment and tube cleaning, and importance of maintaining a leak-free machine.

SAFETY DEVICES AND PROCEDURES — Electrical disconnects, relief device inspection, and handling refrigerant.

CHECK OPERATOR KNOWLEDGE — Start, stop, and shutdown procedures, safety and operating controls, refrigerant and oil charging, and job safety.

REVIEW THE START-UP, OPERATION, AND MAINTENANCE MANUAL.

OPERATING INSTRUCTIONS

Operator Duties

1. Become familiar with refrigeration machine and related equipment before operating the machine.
2. Prepare the system for start-up, start and stop the machine, and place the system in a shutdown condition.
3. Maintain a log of operating conditions and recognize any abnormal readings.
4. Inspect the equipment, make routine adjustments, and perform a Control Test. Maintain the proper oil and refrigerant levels.
5. Protect the system from damage during shutdown periods.
6. Maintain set point, time schedules, and other PIC functions.

Prepare the Machine for Start-Up — Follow the steps described in the Initial Start-Up section on page 56.

To Start the Machine

1. Start the water pumps, if not automatic.
2. On the LID default screen, press the LOCAL or CCN softkey to start the system. If the machine is in the OCCUPIED mode, and all machine timers have expired, the start sequence will start. Follow the procedure described in the Start-Up/Shutdown/Recycle section on page 37.

Check the Running System — After the compressor starts, the operator should monitor the LID display and observe the parameters for normal operating conditions:

1. The oil sump temperature should be 20-40 F (11-20 C) above the condenser refrigerant temperature. At start-up, the oil sump temperature will rapidly decrease. It will then slowly rise to the compressor discharge temperature. After start-up, the minimum oil sump temperature should be 20 F (11 C) above the condenser refrigerant temperature. The oil sump temperature is dependent upon the compressor discharge refrigerant temperature.
2. When the compressor is running, the oil sump should be at least ¾ full. The liquid level should be visible in the separator sight glass.
3. The oil pressure displayed on the LID default screen is equal to the difference between the oil pressure and evaporator pressure transducer readings. Both readings are shown on the Status01 table. Typically the reading will be 4 to 20 psi (28 to 138 kPa) [1.4 to 7 psi (9.7 to 48.3 kPa)] at initial start up until oil pressure ramp up is complete. The full load reading is approximately 120 psi (821 kPa) [78 psi (538 kPa)].
4. The moisture indicator (dry-eye) sight glass on the refrigerant motor cooling line should indicate refrigerant flow and a dry condition.
5. The condenser pressure and temperature varies with the machine design conditions. Typically the pressure will range between 100 and 210 psig (690 to 1450 kPa) [60 to 135 psig (329 to 780 kPa)] with a corresponding temperature range of 60 to 105 F (15 to 41 C). The condenser entering water temperature should be controlled below the specified design entering water temperature to save on compressor kilowatt requirements but, not be below 55 F (12.8 C).
6. Cooler pressure and temperature also will vary with the design conditions. Typical pressure range will be between 60 and 80 psig (410 and 550 kPa) [30 to 40 psig (204 to 260 kPa)] with temperature ranging between 34 and 45 F (1 and 8 C).
7. The compressor may operate at full capacity for a short time after the pulldown ramping has ended, even though the building load is small. The active electrical demand setting can be overridden to limit the compressor IKW (input kilowatt), or the pulldown rate can be decreased to avoid a high demand charge for the short period of high demand operation. Pulldown rate can be based on load rate or temperature rate. It is accessed on the Equipment Configuration menu Config table (Table 3, Example 5).

To Stop the Machine

1. The occupancy schedule will start and stop the machine automatically once the time schedule is set up.
2. By pressing the Stop button for one second, the alarm light will blink once to confirm that the button has been pressed. Then the compressor will follow the normal shutdown sequence as described in the Controls section page 13. The machine will not restart until the CCN or LOCAL softkey is pressed. The machine is now in the OFF mode.

   If the machine fails to stop, in addition to action that the PIC will initiate, the operator should open the slide valve to reduce machine load by overriding the slide valve count to −20. Then, the operator should open the main disconnect.

⚠ WARNING

Do not attempt to stop the machine by opening an isolating knife switch. High intensity arcing may occur. *Do not restart* the machine until the problem is diagnosed and corrected.

After Limited Shutdown — No special preparations should be necessary. Follow the regular preliminary checks and starting procedures.

Extended Shutdown — The refrigerant should be transferred into the storage vessel (if supplied; see Pumpout and Refrigerant Transfer Procedures) in order to reduce machine pressure and possibility of leaks. Maintain a holding charge of 5 to 10 lbs (2.27 to 4.5 kg) of refrigerant to prevent air from leaking into the machine.

If freezing temperatures are likely to occur in the machine area, drain the chilled water, condenser water, and the pumpout condenser water circuits to avoid freeze-up. Keep the waterbox drains open.

Leave the oil charge in the machine with the oil heater (if applicable) and controls energized to maintain the minimum oil sump temperature.

After Extended Shutdown — Be sure that the water system drains are closed. It may be advisable to flush the water circuits to remove any soft rust which may have formed. This is a good time to brush the tubes if necessary.

Check the cooler pressure on the LID default screen, and compare to the original holding charge that was left in the machine. If (after adjusting for ambient temperature changes) any loss in pressure is indicated, check for refrigerant leaks. See Check Machine Tightness section, page 39.

Recharge the machine by transferring refrigerant from the storage tank (if supplied). Follow the Pumpout and Refrigerant Transfer Procedures section. Observe freeze-up precautions.

Carefully make all regular preliminary and running system checks. Perform a Control Test before start-up. If the oil level appears abnormally high, the oil may have absorbed refrigerant. Frame 4 machines are able to start with an abnormally high oil level. Make sure that the oil temperature is above refrigerant temperature plus 35° F (19° C) (Frame 1 and 2 machines only).

NOTE: Frame 4 machines do not have an oil heater.

Cold Weather Operation — When the entering condenser water drops very low, to a minimum of 55 F (13 C), the PIC can automatically cycle the cooling tower fans off to keep the temperature up. Piping may also be arranged to bypass the cooling tower.

Slide Valve Operation — Manual operation of the slide valve to check control operation, or to control the valve in an emergency operation, is possible by overriding the manual slide valve count. Access the Status01 table on the LID and highlight *MANUAL SLIDE VALVE COUNT*. To control slide valve movement, enter a desired count value. The *MANUAL SLIDE VALVE COUNT* has an allowable input range of plus or minus 20 to provide up to 10 seconds of slide valve movement in the selected direction. If the counts are positive then the slide valve position will increase to load the compressor and vice versa. To release the valve to PIC control press the RELEASE softkey.

NOTE: The valve can be increased with manual control to override the pulldown rate during start-up. However, motor current above the electrical demand setting, capacity overrides, and chilled water below control point will override the manual count and decrease the slide valve position. For descriptions of capacity overrides and set points, see the Controls section.

Entering a 0 count value will cause the slide valve to maintain a HOLD state. In this condition, the slide valve will respond to maintain the chilled water (ΔT) temperature when the override occurs.

Refrigeration Log — A refrigeration log, such as the one shown in Fig. 40, provides a convenient checklist for routine inspection and maintenance, and provides a continuous record of machine performance. It is an aid in scheduling routine maintenance and in diagnosing machine problems.

Keep a record of the machine pressures, temperatures, and liquid levels on a sheet similar to that shown. Automatic recording of PIC data is possible through the use of CCN devices such as the Data Collection module and a Building Supervisor. Contact your Carrier representative for more information.

Plant _____ MACHINE MODEL NO. _____ MACHINE SERIAL NO. _____ REFRIGERANT TYPE _____

DATE_____	COOLER							CONDENSER							COMPRESSOR									OPER-ATOR INITIALS	REMARKS
TIME	Refrigerant		Water					Refrigerant		Water					ROTOR INLET TEMP	DISCHARGE TEMP	Oil				Motor				
	Press.	Temp	Pressure			Temp		Press.	Temp	Pressure			Temp				Press.	Filter Diff. Press.	Temp	Level	Voltage	FLA _____ Amperage			
			In	Out	GPM	In	Out			In	Out	GPM	In	Out											

REMARKS: Indicate shutdowns on safety controls, repairs made, oil or refrigerant added or removed, operating hours, start counts, and air exhausted. Include amounts.

Fig. 40 — Refrigeration Log: Carrier 23XL Hermetic Screw Refrigeration Machine

PUMPOUT AND REFRIGERANT TRANSFER PROCEDURES

Preparation — The 23XL may come equipped with isolation valves and/or a pumpout system/optional storage tank for the purpose of servicing the unit. The pumpout system may come equipped with or without a storage tank. Three possibilities are available:

1. If isolation valves are supplied, the refrigerant can be pumped to either the cooler vessel or the condenser vessel by using the optional pumpout system without a storage tank.
2. Whether or not isolation valves are supplied, the refrigerant can be pumped to and isolated in an optional storage tank by using the optional pumpout system.
3. If isolation valves are not supplied, a pumpout system with a storage tank is needed.

The following procedures are used to describe how to transfer refrigerant from vessel to vessel and perform machine evacuation.

Operating the Optional Pumpout Compressor

1. Be sure that the suction and the discharge service valves on the optional pumpout compressor are open (backseated) during operation. Rotate the valve stem fully counterclockwise to open. Frontseating the valve closes the refrigerant line and opens the gage port to compressor pressure.
2. Make sure that the compressor holddown bolts have been loosened to allow free spring travel.
3. Open the refrigerant inlet valve on the pumpout compressor.
4. Oil should be visible in the compressor sight glass under all operating conditions and during shutdown. If oil is low, add oil as described under Optional Pumpout System Maintenance section, page 67. The pumpout unit control wiring schematic is detailed in Fig. 41.

TO READ REFRIGERANT PRESSURES during pumpout or leak testing:

1. The LID display on the machine control center is suitable for determining refrigerant-side pressures and low (soft) vacuum. For evacuation or dehydration measurement, use a quality vacuum indicator or manometer to ensure the desired range and accuracy. This can be placed on the Schrader connections on each vessel by removing the pressure transducer.
2. To determine storage tank pressure, a 30 in.-0-400 psi (-101-0-2760 kPa) gage is attached to the vessel.
3. Refer to Fig. 31-34, and 42 for valve locations and numbers.

⚠ CAUTION

Transfer, addition, or removal of refrigerant in spring-isolated machines may place severe stress on external piping if springs have not been blocked in both up and down directions.

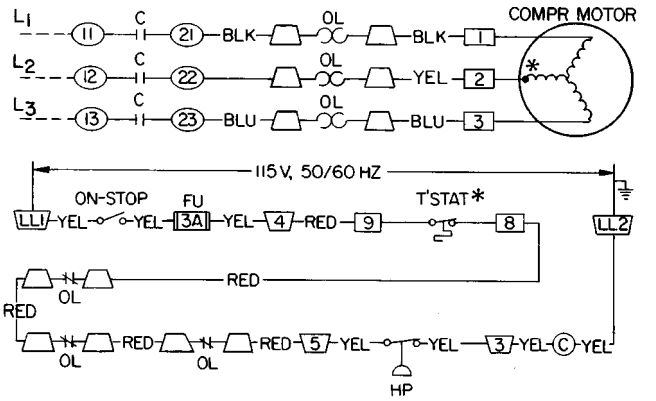
Machines with Storage Tanks — If the machine has isolation valves, leave them open for the following procedures. The letter ''C'' describes a closed valve. Valves 9 and 10 on the storage tank are always closed.

TRANSFER REFRIGERANT FROM STORAGE TANK TO MACHINE

NOTE: Valve 14 is only available on Frame 1 and 2 machines. Valves 16 and 17 are only available on Frame 4 machines.

1. Equalize refrigerant pressure.
   a. Use the Control Test Terminate Lockout to turn on water pumps and monitor pressures.
   b. Close pumpout/storage tank valves 2, 4, 5, and 8, and close the appropriate machine charging valve 7A and 7B; open appropriate machine isolation valves 11 through 17.
   c. Open pumpout/storage tank valves 3 and 6, open machine valves 1a and 1b.

VALVE	1a	1b	2	3	4	5	6	7a	7b	8	11	12	13	14	15	16	17
CONDITION			C		C	C		C	C	C							



C — Contactor
Fu — Fuse, 3 Amps
HP — High-Pressure Cutout
OL — Compressor Overload
T'stat — Internal Thermostat

Compressor Terminal
Contactor Terminal
Overload Terminal
Pumpout Unit Terminal

*Bimetal thermal protector imbedded in motor winding.

Fig. 41 — 23XL Pumpout Unit Wiring Schematic

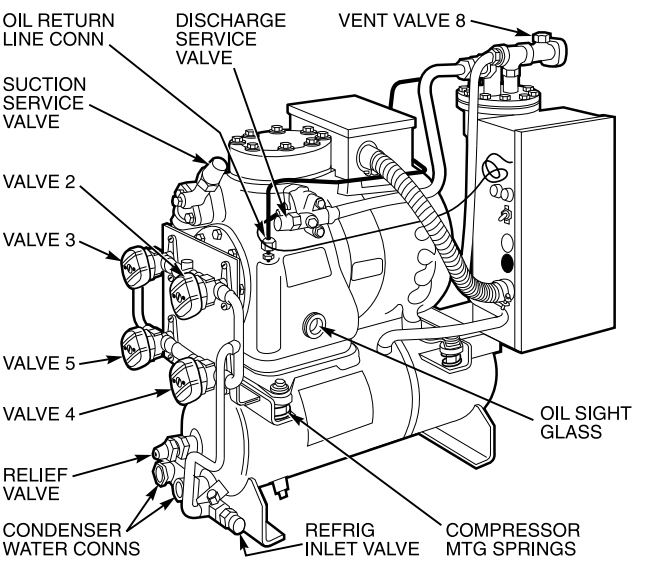


Fig. 42 — Optional Pumpout System

d. Gradually crack open valve 5 to increase machine pressure to 68 psig (469 kPa) [35 psig (141 kPa)]. Slowly feed refrigerant to prevent freeze up.

e. Open valve 5 fully after reaching 68 psig (469 kPa) [35 psig (141 kPa)]. Open liquid line valves 7a and 7b until refrigerant pressure equalizes.

VALVE	1a	1b	2	3	4	5	6	7a	7b	8	11	12	13	14	15	16	17
CONDITION			C		C					C							

2. Transfer remaining refrigerant.

a. Close valve 5 and open valve 4.

VALVE	1a	1b	2	3	4	5	6	7a	7b	8	11	12	13	14	15	16	17
CONDITION			C			C				C							

b. Turn off the water pumps through the LID.

c. Turn off the pumpout condenser water, and turn on the pumpout compressor to push liquid out of the storage tank.

d. Close liquid line valves 7a and 7b.

e. Turn off the pumpout compressor.

f. Close valves 3 and 4.

g. Open valves 2 and 5.

VALVE	1a	1b	2	3	4	5	6	7a	7b	8	11	12	13	14	15	16	17
CONDITION				C	C			C	C	C							

h. Turn on pumpout condenser water.

i. Run the pumpout compressor until the storage tank pressure reaches 5 psig (34 kPa) (18 in. Hg [40 kPa abs.] if repairing the tank).

j. Turn off the pumpout compressor.

k. Close valves 1a, 1b, 2, 5, and 6.

l. Turn off pumpout condenser water.

VALVE	1a	1b	2	3	4	5	6	7a	7b	8	11	12	13	14	15	16	17
CONDITION	C	C	C	C	C	C	C	C	C	C							

TRANSFER THE REFRIGERANT FROM MACHINE TO STORAGE TANK

1. Equalize refrigerant pressure.

a. Valve positions:

VALVE	1a	1b	2	3	4	5	6	7a	7b	8	11	12	13	14	15	16	17
CONDITION			C		C	C		C	C	C							

b. Slowly open valve 5 and liquid line valves 7a and 7b to allow liquid refrigerant to drain by gravity into the storage tank.

VALVE	1a	1b	2	3	4	5	6	7a	7b	8	11	12	13	14	15	16	17
CONDITION			C		C					C							

2. Transfer the remaining liquid.

a. Turn off pumpout condenser water. Place valves in the following positions:

VALVE	1a	1b	2	3	4	5	6	7a	7b	8	11	12	13	14	15	16	17
CONDITION				C	C					C							

b. Run the pumpout compressor for 30 minutes then close valves 7a and 7b.

c. Turn off the pumpout compressor.

VALVE	1a	1b	2	3	4	5	6	7a	7b	8	11	12	13	14	15	16	17
CONDITION				C	C			C	C	C							

3. Remove any remaining refrigerant.

a. Turn on water pumps through the use of the Control Test, Pumpdown table.

b. Turn on pumpout condenser water.

c. Place valves in the following positions:

VALVE	1a	1b	2	3	4	5	6	7a	7b	8	11	12	13	14	15	16	17
CONDITION			C			C		C	C	C							

d. Run the pumpout compressor until the machine pressure reaches 65 psig (448 kPa), [30 psig (207 kPa)], then shut off the pumpout. Warm condenser water will boil off any entrapped liquid refrigerant and machine pressure will rise.

e. When the pressure rises to 70 psig (483 kPa) [40 psig (276 kPa)], turn on the pumpout compressor until the pressure again reaches 65 psig (448 kPa) [30 psig (207 kPa)], and then turn off the compressor. Repeat this process until the pressure no longer rises, then turn on the pumpout compressor and pumpout until the pressure reaches the pressure level specified by the U.S. EPA's latest publication of 40 CFR part 80.

f. Close valves 1a, 1b, 3, 4, and 6.

VALVE	1a	1b	2	3	4	5	6	7a	7b	8	11	12	13	14	15	16	17
CONDITION	C	C	C	C	C	C	C	C	C	C							

g. Turn off the pumpout condenser water and continue with the Control Test for Pumpdown, which will lock out the machine compressor for operation.

4. Establish vacuum for service.

a. In order to conserve refrigerant, operate the pumpout compressor until the machine pressure is reduced to 18 in. Hg vac., ref 30 in. bar. (40 kPa. abs.) following Step 3e.

Machines with Isolation Valves — Transfer all refrigerant to condenser vessel.

NOTE: Valve 14 is only available or Frame 1 and 2 machines. Valves 16 and 17 are only available on Frame 4 machines.

1. Push refrigerant into condenser.

a. Valve positions:

VALVE	1a	1b	2	3	4	5	8	11	12	13	14	15	16	17
CONDITION				C	C		C		C	C	C	C	C	C

b. Turn off machine water pumps and pumpout condenser water.

c. Turn on pumpout compressor to push liquid out of the cooler/compressor.

d. When all liquid has been pushed into the condenser, close cooler isolation valve 11.

e. Access the Control Test Pumpdown table on the LID display to turn on the machine water pumps.

f. Turn off the pumpout compressor.

2. Evacuate gas from cooler/compressor vessel.

a. Close pumpout valves 2 and 5, and open valves 3 and 4.

VALVE	1a	1b	2	3	4	5	8	11	12	13	14	15	16	17
CONDITION			C			C	C	C	C	C	C	C	C	C

b. Turn on pumpout condenser water.

c. Run pumpout until the compressor reaches 18 in. Hg vac (40 kPa abs.). Monitor pressures on the LID and on refrigerant gages.

d. Close valve 1a.

e. Turn off pumpout compressor.

f. Close valves 1b, 3, and 4.

g. Turn off pumpout condenser water.

VALVE	1a	1b	2	3	4	5	8	11	12	13	14	15	16	17
CONDITION	C	C	C	C	C	C	C	C	C	C	C	C	C	C

h. Proceed to Pumpdown test on the LID to turn off machine water pumps and lock out machine compressor.

TRANSFER ALL REFRIGERANT TO COOLER/ COMPRESSOR VESSEL

1. Push refrigerant into the cooler vessel.
   a. Valve positions:

VALVE	1a	1b	2	3	4	5	8	11	12	13	14	15	16	17
CONDITION			C			C	C		C	C	C	C	C	C

   b. Turn off machine water pumps and pumpout condenser water.
   c. Turn on pumpout compressor to push refrigerant out of the condenser.
   d. When all liquid is out of the condenser close cooler isolation valve 11.
   e. Turn off the pumpout compressor.
2. Evacuate gas from the condenser vessel.
   a. Access the Control Test, Pumpdown table on the LID display to turn on the machine water pumps.
   b. Close pumpout valves 3 and 4; open valves 2 and 5.

VALVE	1a	1b	2	3	4	5	8	11	12	13	14	15	16	17
CONDITION				C	C		C	C	C	C	C	C	C	C

   c. Turn on pumpout condenser water.
   d. Run the pumpout until the compressor reaches 18 in. Hg vac (40 kPa abs.). Monitor pressure at the LID and refrigerant gages.
   e. Close valve 1b.
   f. Turn off pumpout compressor.
   g. Close valves 1a, 2, and 5.

VALVE	1a	1b	2	3	4	5	8	11	12	13	14	15	16	17
CONDITION	C	C	C	C	C	C	C	C	C	C	C	C	C	C

   h. Turn off pumpout condenser water.
   i. Proceed to Pumpdown test on the LID to turn off machine water pumps and lockout machine compressor.

Return Refrigerant to Normal Operating Conditions

NOTE: Valve 14 is only available on Frame 1 and 2 machines. Valves 16 and 17 are only available on Frame 4 machines.

1. Be sure that the vessel that was opened has been evacuated.
2. Access the Control Test, Terminate Lockout table to view vessel pressures and turn on machine water pumps.
3. Open valves 1a, 1b, and 3.

VALVE	1a	1b	2	3	4	5	8	11	12	13	14	15	16	17
CONDITION			C		C	C	C	C	C	C	C	C	C	C

4. Crack open valve 5, gradually increasing pressure in the evacuated vessel to 68 psig (469 kPa) [35 psig (141 kPa)]. Feed refrigerant slowly to prevent tube freeze up.
5. Leak test to ensure vessel integrity.
6. Open valve 5 fully.

VALVE	1a	1b	2	3	4	5	8	11	12	13	14	15	16	17
CONDITION			C		C		C	C	C	C	C	C	C	C

7. Open valve 11 to equalize the liquid refrigerant level between vessels.
8. Close valves 1a, 1b, 3, and 5.
9. Open isolation valves 12 and 13.

VALVE	1a	1b	2	3	4	5	8	11	12	13	14	15	16	17
CONDITION	C	C	C	C	C	C	C				C	C	C	C

10. Proceed to Control Test Terminate Lockout table to turn off water pumps and enable the machine compressor for start-up.

GENERAL MAINTENANCE

Refrigerant Properties — HCFC-22 and HFC-134a are the standard refrigerants in the 23XL. At normal atmospheric pressure, HCFC-22 will boil at −41 F (−40.5 C) and HFC-134a will boil at −14 F (−25 C), and must, therefore, be kept in pressurized containers or storage tanks. The refrigerants are practically odorless when mixed with air. Both refrigerants are non-combustible at atmospheric pressure. Read the Material Safety Data Sheet and the latest ASHRAE Safety Guide for Mechanical Refrigeration to learn more about safely handling of these refrigerants.

⚠ DANGER

HCFC-22 and HFC-134a will dissolve oil and some nonmetallic materials, dry the skin, and, in heavy concentrations, may displace enough oxygen to cause asphyxiation. In handling this refrigerant, protect the hands and eyes and avoid breathing fumes.

Adding Refrigerant — Follow the procedures described in the Charge Refrigerant into Machine section, page 55.

⚠ WARNING

Always use the compressor pumpdown function in the Control Test mode to turn on the evaporator pump and lock out the compressor when transferring refrigerant. Liquid refrigerant may flash into a gas and cause possible freeze-up when the machine pressure is below 65 psig (448 kPa) [30 psig (207 kPa)].

Removing Refrigerant — If the optional pumpout system is used, the 23XL refrigerant charge may be transferred to a storage vessel or within the condenser or cooler if isolation valves are present. Follow procedures in the Pumpout and Refrigerant Transfer Procedures section when removing refrigerant from the storage tank to the machine.

Adjusting the Refrigerant Charge — If the addition or removal of refrigerant is required for improved machine performance, follow the procedures given under the Trim Refrigerant Charge section, on page 64.

Refrigerant Leak Testing — Because HCFC-22 and HFC-134a are above atmospheric pressure at room temperature, leak testing can be performed with refrigerant in the machine. Use an electronic leak detector, halide leak detector, soap bubble solution, or ultra-sonic leak detector. Be sure that the room is well ventilated and free from concentration of refrigerant to keep false readings to a minimum. Before making any necessary repairs to a leak, transfer all refrigerant from the leaking vessel.

Refrigerant Leak Rate — ASHRAE recommends that machines should be immediately taken off line and repaired if the refrigerant leakage rate for the entire machine is more than 10% of the operating refrigerant charge per year.

Additionally, Carrier recommends that leaks totalling less than the above rate but more than a rate of 1 lb (0.5 kg) per year should be repaired during annual maintenance or whenever the refrigerant is pumped over for other service work.

Test After Service, Repair, or Major Leak — If all refrigerant has been lost or if the machine has been opened for service, the machine or the affected vessels must be pressured and leak tested. Refer to the Leak Test Machine section to perform a leak test.

⚠ DANGER

HCFC-22 and HFC-134a will dissolve oil and some nonmetallic materials, dry the skin, and, in heavy concentrations, may displace enough oxygen to cause asphyxiation. In handling this refrigerant, protect the hands and eyes and avoid breathing fumes.

REFRIGERANT TRACER — Use an environmentally acceptable refrigerant as a tracer for leak test procedures.

TO PRESSURIZE WITH DRY NITROGEN — Another method of leak testing is to pressure with nitrogen only and use soap bubble solution or an ultrasonic leak detector to determine if leaks are present. This should only be done if all refrigerant has been evacuated from the vessel.

1. Connect a copper tube from the pressure regulator on the cylinder to the refrigerant charging valve. Never apply full cylinder pressure to the pressurizing line. Follow the listed sequence.
2. Open the charging valve fully.
3. Slowly open the cylinder regulating valve.
4. Observe the pressure gage on the machine and close the regulating valve when the pressure reaches test level. *Do not exceed* 140 psig (965 kPa).
5. Close the charging valve on the machine. Remove the copper tube if no longer required.

Repair the Refrigerant Leak, Retest, and Apply Standing Vacuum Test — After pressurizing the machine, test for leaks with a soap bubble solution, an electronic leak detector, a halide torch, or an ultrasonic leak detector. Bring the machine back to atmospheric pressure, repair any leaks found, and retest.

After retesting and finding no leaks, apply a standing vacuum test. Then dehydrate the machine. Refer to the Standing Vacuum Test and Machine Dehydration in the Before Initial Start-Up section, page 48.

Trim Refrigerant Charge — If it becomes necessary to adjust the refrigerant charge to obtain optimum machine performance, operate the machine at design load and then add or remove refrigerant slowly until the difference between leaving chilled water temperature and the cooler refrigerant temperature reaches design conditions. *Do not overcharge.* For superheat information, see the Troubleshooting section on page 68.

Refrigerant may be added either through the optional storage tank or directly into the machine as described in the section entitled, Refrigerant Charging.

To remove any excess refrigerant, follow the procedure in Transfer Refrigerant from Machine to Storage Tank section, Steps 1a, b on page 62.

WEEKLY MAINTENANCE

Check the Lubrication System — Mark the oil level on the sight glasses and observe the level each week while the machine is shut down.

If the level goes below the sight glass, the oil reclaim system will need to be checked for proper operation. If additional oil is required, add it through the oil charging valve (Fig. 2A and 2B). A hand pump is required for adding oil against refrigerant pressure. The oil charge is approximately 4.2 gal (15.9 L) for Frame 1 and 2 machines and 10 gal (38 L) for Frame 4 machines. The oil *must* meet Carrier's specifications for the 23XL. Refer to Changing Oil and Oil Filter section. Any oil that is added should be logged by noting the amount and date in Fig. 40 on page 60. Any oil that is added due to oil loss not related to service will eventually return to the sump. It must be removed when the level is above the sight glass.

NOTE: Frame 4 machines do not use an oil heater.

On Frame 1 and 2 machines, a 500-watt oil heater is controlled by the PIC to maintain oil temperature above 140 F (60 C) [120 F (48.9 C)] or refrigerant temperature plus 60 F (15.6 C) [40 F (4.4 C)] when the compressor is off (see the Controls section on page 13). The LID Status02 table displays whether the heater is energized or not. If the PIC shows that the heater is energized, but the sump is not heating up. If the sump is not heating up, the power to the oil heater may be off or the oil level may be too low. Check the oil level, the oil heater contactor voltage, and oil heater resistance.

The PIC will not permit compressor start-up if the oil temperature is too low (Fame 1 and 2 machines). The control will continue with start-up only after the temperature is within limits.

SCHEDULED MAINTENANCE

Establish a regular maintenance schedule based on the actual machine requirements such as machine load, run hours, and water quality. The time intervals listed in this section are offered as guides to service only.

Service Ontime — The LID will display a *SERVICE ONTIME* value on the Status01 table. This value should be reset to zero by the service person or the operator each time major service work is completed so that time between service can be seen.

Inspect the Control Center — Maintenance is generally limited to general cleaning and tightening of connections. Vacuum the cabinet to eliminate dust build-up. In the event of machine control malfunctions, refer to the Troubleshooting Guide section for control checks and adjustments.

⚠ CAUTION

Be sure power to the control center is off when cleaning and tightening connections inside the control center.

Check Safety and Operating Controls Monthly — To ensure machine protection, the Automated Control Test in the service menu should be done at least once per month. See Table 4 for safety control settings.

Changing Oil and Oil Filter — If the pressure drop across the filter has approached the OIL FILTER PRESS ALERT value on the Equipment Service, Service1 table, change oil filter as needed. Otherwise, change the oil filter on a yearly basis.

Change the oil after the first year of operation. Then, change the oil at least every three years, or as needed. However, if a continuous oil monitoring system is present and/or a yearly oil analysis is performed, the time between oil changes may be extended. The 23XL Frame 1 and 2 machines use approximately 4.2 gal (15.9 L) of oil. The 23XL Frame 4 machines use approximately 10 gal (38 L) of oil. See Oil Specification section on page 66 for additional information.

⚠ CAUTION

This product is hygroscopic. Containers should remain tightly sealed in a clean and dry environment to prevent moisture absorption from the air.

FRAME 1 AND 2 MACHINES — The 23XL oil sump can be isolated to change the oil filter and oil while the refrigerant remains inside the machine. Use the following procedure to change the oil and oil filter (if required):

IMPORTANT: Remove oil from Frame 1 and 2 machines before changing the oil filter. Refer to Fig. 2A and 3.

1. Make sure the compressor is off and the disconnect for the compressor is open.
2. Open the control and oil heater circuit breaker in order to turn off the power to the oil heater.
3. Close the 3 oil sump isolation valves. One isolation valve is upstream and one isolation valve is downstream of the oil sump. The third isolation valve is in the oil sump vent line.

⚠ WARNING

Be sure the power to the oil heater is off when the oil sump is isolated and full. If the oil heater remains energized, over-pressurization of the oil sump could result in the failure of the oil solenoid valve, discharge of hot oil, and personal injury.

4. Connect an oil charging hose to the oil drain valve. See Fig. 3. Place the other end of the oil charging hose in a clean container suitable for used oil. A portion of the oil drained from the sump should be used as an oil sample and should be sent to a laboratory for proper analysis. *Do not contaminate this sample.*
5. Slowly open the drain valve in order to drain the oil from the sump.

⚠ WARNING

The oil sump is at high pressure. Relieve pressure slowly.

6. Once the oil has been drained, place absorbent material under the oil sump to catch any oil that may leak out once the oil sump cover is opened. Continue with Steps 7, 8, and 9 if a new oil filter is required. Proceed to Step 10 if no oil filter change is required.
7. Remove the 6 bolts from the end of the oil sump and remove the oil sump cover.
8. Remove the oil filter retaining spring. Remove and properly discard the oil filter.
9. Insert a new oil filter. Seat the filter retaining spring against the flange stop. Install the oil sump cover with a new O-ring. Insert and tighten the 6 bolts that secure the oil sump cover.
10. Evacuate the oil sump by placing a vacuum pump on the drain valve. Follow normal evacuation procedures. Shut off the drain valve when the oil sump has been evacuated. Charge new oil through the drain valve.
11. Add oil (approximately 4.2 gal [15.9 L]) until it can be seen at the lower edge of the oil sump sight glass. The oil sight glass will not fill completely since a small amount of gas will be trapped inside, even under vacuum conditions.
12. Open all 3 isolation valves (previously closed in Step 3). Apply power to the controls and oil heater.
13. The oil level will rise once the refrigerant gets absorbed into the oil.

FRAME 4 MACHINES — Use the following procedures to change the oil filter and/or oil on Frame 4 machines. Oil can remain in Frame 4 machines when changing the oil filter. Refer to Fig. 2B and 4.

Changing Oil Filter

1. Make sure the compressor is off and the disconnect for the compressor starter is open.
2. Close both oil filter isolation valves. See Fig. 4.
3. Place a container underneath the oil filter assembly.
4. Slowly open the vent plug, located on top of the oil filter housing, to relieve pressure. *Do not remove the plug.* When a Schrader valve is provided, use it to relieve the pressure.
5. Remove the filter canisters by unscrewing the retainer nut. The filter may now be removed and disposed of properly.
6. Install new oil filter. Install the new O-ring. Tighten the retainer nut.
7. Partially open the isolation valve located near the oil separator. Bleed the excess air from the vent plug. Once oil starts escaping from the vent plug, close the isolation valve. Tighten the vent plug on top of the oil filter housing.
8. If a Schrader valve is supplied, evacuate the oil filter by connecting the vacuum pump to the Schrader valve.

Changing Oil

NOTE: A hand pump or portable electric oil pump will be required to complete the following operation.

1. Transfer the refrigerant into the condenser (for vessel that can be isolated) or storage tank.
2. When the machine pressure equals a maximum of 5 psi (34 kPa), drain the oil by opening the oil charging valve, located on the bottom of the oil separator.
3. Change the oil filter as described in the Changing Oil Filter section for Frame 4 machines.
4. Charge the oil separator with approximately 10 gal (39 L) of oil. The oil level should be in the center of the lower sight glass.

Oil Specification — If oil is to be added, it must meet the following Carrier specifications:

- Carrier Part Number PP23BZ104
- Oil type . . . . . Inhibited polyolester-based synthetic compressor lubricant suitable for use in screw compressors where high viscosity and compatibility with HCFC 22 and HFC-134a refrigerants is required.
- ISO Viscosity Grade 220
- Specific Gravity 0.981
- Viscosity, cSt at 40 C (104 F) . . . . . 210 to 230
  - cSt at 100 C (212 F) . . . . . 18 to 21
  - SSU at 100 F (38 C) . . . . . 1005 ± 45
  - SSU at 210 F (99 C) . . . . . 91 ± 7
- Floc Point (maximum) . . . . . −90 F (−68 C)
- Pour Point (maximum) . . . . . −6 F (−21 C)
- Flash Point (minimum) . . . . . 428 F (220 C)
- Moisture Content (maximum) . . . . . 100 ppm
- Acid Number (maximum) . . . . . 0.5 mg KOH/gram
- Miscibility Range with HCFC-22 . . . . . −90 to 200 F (−68 to 93 C)
  - with HFC-134a . . . . . −4 to 180 F (−2 to 82 C)

⚠ CAUTION

This product is hygroscopic. Containers should remain tightly sealed in a clean and dry environment to prevent moisture absorption from the air.

This oil (part number PP-23-BZ-104) may be ordered from your local Carrier represesentative.

Oil Separator Coalescer

FRAME 1 AND 2 MACHINES — The oil separator coalescing element is replaceable and has an estimated life of 15 years. Proper maintenance procedures require the coalescer to be changed approximately 100 hours after a major compressor teardown or machine overhaul.

FRAME 4 MACHINES — Frame 4 machines do not have a replaceable oil coalescer.

Refrigerant Filter/Drier — A refrigerant filter/drier, located on the motor cooling line should be changed once a year, or as necessary, if filter condition indicates a need for less or more frequent replacement. Change the filter with the machine pressure at 0 psig (0 kPa) by transferring the refrigerant to the condenser vessel, (if isolation valves are present) or a storage tank. A moisture indicator (dry eye) sight glass is located beyond this filter to indicate the volume of moisture in the refrigerant. If the moisture indicator indicates moisture, locate the source of water immediately by performing a thorough leak check.

Refrigerant Strainers (Frame 1 and 2 Machines Only) — The oil reclaim system has two strainers. One is located on the eductor suction line, and one on the condenser gas line. Replace these strainers once per year, or as necessary if strainer condition indicates a need for less or more frequent replacement. Change these strainers with the cooler/compressor vessel at 0 psig (0 kPa) by transferring the refrigerant charge to a storage vessel or the condenser.

Inspect Refrigerant Float System — Perform inspection every 5 years, if required, or when the machine is opened for service.

Transfer the refrigerant into the cooler vessel (if isolation valves are present) or into a storage tank. Remove the float access cover. Clean the chamber and valve assembly thoroughly. Be sure that the valve moves freely. Ensure that all openings are free of obstructions. Examine the cover gasket and replace if necessary.

Inspect Relief Valves and Piping — The relief valves on this machine protect the system against the potentially dangerous effects of overpressure. To ensure against damage to the equipment and possible injury to personnel, these devices must be kept in peak operating condition.

As a minimum, the following maintenance is required.

1. At least once a year, disconnect the vent piping at the valve outlet and carefully inspect the valve body and mechanism for any evidence of internal corrosion or rust, dirt, scale, leakage, etc.
2. If corrosion or foreign material is found, do not attempt to repair or recondition. *Replace the valve.*
3. If the machine is installed in a corrosive atmosphere or the relief valves are vented into a corrosive atmosphere, make valve inspections at more frequent intervals.

Compressor Bearing Maintenance — The key to good bearing maintenance is proper lubrication. Use the proper grade of oil, maintained at recommended level, temperature, and pressure. Inspect the lubrication system regularly and thoroughly.

Excessive bearing wear can be detected through increased vibration. If this symptom appears, contact an experienced and responsible service organization to perform vibration analysis on the compressor.

Compressor Rotor Check — Use Carrier specified oil. Excessive compressor rotor wear is shown by a lack of performance. If a lack of performance is noted, have the compressor rotors inspected by a trained service person.

The rotors can be visually inspected once every 5 to 10 years or as needed depending on machine operating conditions.

Inspect the Heat Exchanger Tubes

COOLER — Inspect and clean the cooler tubes at the end of the first operating season. Because these tubes have internal ridges, a rotary-type tube cleaning system is necessary to fully clean the tubes. Upon inspection, the tube condition will determine the scheduled frequency for cleaning, and will indicate whether water treatment is adequate in the chilled water/brine circuit. Inspect the entering and leaving chilled water temperature sensors for signs of corrosion or scale. Replace the sensor if corroded or remove any scale if found.

CONDENSER — Since this water circuit is usually an open-type system, the tubes may be subject to contamination and scale. Clean the condenser tubes with a rotary tube cleaning system at least once per year and more often if the water is contaminated. Inspect the entering and leaving condenser water sensors for signs of corrosion or scale. Replace the sensor if corroded or remove any scale if found.

Higher than normal condenser pressures, together with the inability to reach full refrigeration load, usually indicate dirty tubes or air in the machine. If the refrigeration log indicates a rise above normal condenser pressures, check the condenser refrigerant temperature against the leaving condenser water temperature. If this reading is more than what the design difference is supposed to be, then the condenser tubes may be dirty or water flow may be incorrect. Because HCFC-22 and HFC-134a are high-pressure refrigerants, air usually does not enter the machine; instead the refrigerant leaks out.

During the tube cleaning process, use brushes especially designed to avoid scraping and scratching the tube wall. Contact your Carrier representative to obtain these brushes. *Do not* use wire brushes.

⚠ CAUTION

Hard scale may require chemical treatment for its prevention or removal. Consult a water treatment specialist for proper treatment.

Water Leaks — Water is indicated during machine operation by the refrigerant moisture indicator on the refrigerant motor cooling line. See Fig. 11 and 12. Water leaks should be repaired immediately.

⚠ CAUTION

Machine must be dehydrated after repair of water leaks. See Machine Dehydration section, page 48.

Water Treatment — Untreated or improperly treated water may result in corrosion, scaling, erosion, or algae. The services of a qualified water treatment specialist should be obtained to develop and monitor a treatment program.

⚠ CAUTION

Water must be within design flow limits, clean, and treated to ensure proper machine performance and to reduce the potential of tubing damage due to corrosion, scaling, erosion, and algae. Carrier assumes no responsibility for chiller damage resulting from untreated or improperly treated water.

Inspect the Starting Equipment — Before working on any starter, shut off the machine, and open all disconnects supplying power to the starter.

⚠ WARNING

The disconnect on the starter front panel does not deenergize all internal circuits. Open all internal and remote disconnects before servicing the starter.

⚠ WARNING

Never open isolating knife switches while equipment is operating. Electrical arcing can cause serious injury.

Inspect starter contact surfaces for wear or pitting on mechanical-type starters. Do not sandpaper or file silver-plated contacts. Follow the starter manufacturer's instructions for contact replacement, lubrication, spare parts ordering, and other maintenance requirements.

Periodically vacuum or blow off accumulated debris on the internal parts with a high-velocity, low-pressure blower.

Power connections on newly installed starters may relax and loosen after a month of operation. Turn power off and retighten. Recheck annually thereafter.

⚠ CAUTION

Loose power connections can cause voltage spikes, overheating, malfunctioning, or failures.

Check Pressure Transducers — Once a year, the pressure transducers should be checked against a pressure gage reading. Check all three transducers: oil pressure, discharge pressure, cooler pressure.

Note the appropriate pressure reading on the Status01 table on the LID. Attach an accurate refrigeration gage to the corresponding pressure fitting. Compare the two readings. If there is a difference in readings, the transducer can be calibrated as described in the Troubleshooting Guide section.

Optional Pumpout System Maintenance — For compressor maintenance details, refer to the 06D, 07D Installation, Start-Up, and Service Instructions.

OPTIONAL PUMPOUT COMPRESSOR OIL CHARGE — Use oil conforming to Carrier specifications for reciprocating compressor usage. Oil requirements are as follows:

- HCFC-22 and HFC-134a
  ISO Viscosity 68
  Viscosity SSU 100 F (38 C). 300
  Carrier Part Number PP23BZ-103

The total oil charge, 4.5 pints (2.6 L), consists of 3.5 pints (2.0 L) for the compressor and one additional pint (0.6 L) for the oil separator.

Oil should be visible in one of the compressor sight glasses during operation and at shutdown. Always check the oil level before operating the compressor. Before adding or changing oil, relieve the refrigerant pressure as follows:

1. Attach a pressure gage to the gage port of either compressor service valve.
2. Close the suction service valve and open the discharge line to the storage tank or the machine.
3. Operate the compressor until the crankcase pressure drops to 2 psig (13 kPa).
4. Stop the compressor and isolate the system by closing the discharge service valve.
5. Slowly remove the oil return line connection (Fig. 42). Add oil as required.
6. Replace the connection and reopen the compressor service valves.

OPTIONAL PUMPOUT SAFETY CONTROL SETTINGS (Fig. 43) — The optional pumpout system high-pressure switch should open at 220 ± 5 psig (1517 ± 34 kPa) and should reset automatically on pressure drop to 190 psig (1310 kPa) for HCFC-22 machines. For machines using HFC-134a, the switch opens at 161 psig (1110 kPa) and closes at 130 psig (896 kPa). Check the switch setting by operating the pumpout compressor and slowly throttling the pumpout condenser water.

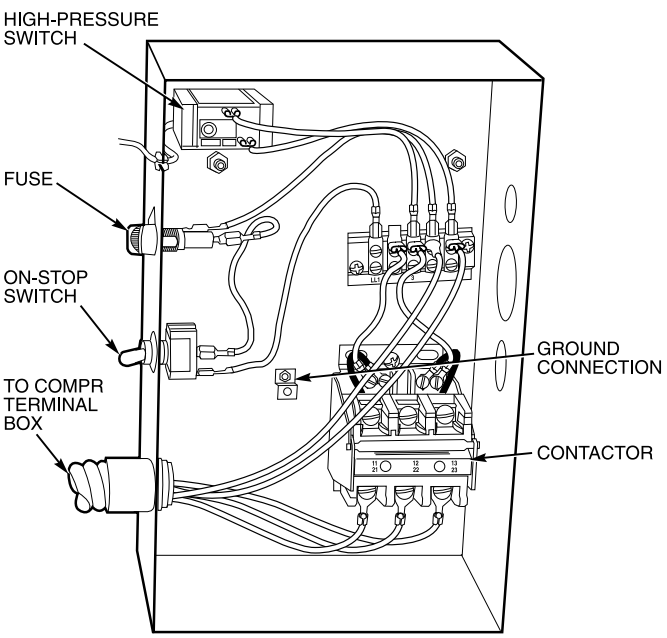


Fig. 43 — Optional Pumpout System Controls

Ordering Replacement Chiller Parts — When ordering Carrier specified parts, the following information must accompany an order.

- machine model number and serial number
- name, quantity, and part number of the part required
- delivery address and method of shipment

TROUBLESHOOTING GUIDE

Overview — The PIC has many features to aid the operator and the technician in troubleshooting a 23XL machine.

- By using the LID display, the chiller actual operating conditions can be viewed while the unit is running.
- When an alarm occurs, the default LID screen will freeze at the time of alarm. The freeze enables the operator to view the machine conditions at the time of alarm. The Status tables will still show the current information. Once all alarms have been cleared, the default LID screens will return to normal operation.
- The Control Algorithm Status tables will display various screens of information in order to diagnose problems with chilled water temperature control, chilled water temperature control overrides, hot gas bypass, and time schedule operation.
- The Control Test feature allows proper operation and testing of temperature sensors, pressure transducers, the slide valve solenoids, water pumps, tower control, and other on/off outputs while the compressor is stopped. It also has the ability to lock off the compressor and turn on water pumps for pumpout operation. The display will show the required temperatures and pressures during these operations.
- Other Service menu tables can access configured items, such as chilled water resets, override set points, etc.
- If an operating fault is detected, an alarm message is generated and displayed on the LID default screen. A more detailed message — along with a diagnostic message — also is stored into the Alarm History table.

Checking the Display Messages — The first area to check when troubleshooting the 23XL is the LID display. If the alarm light is flashing, check the primary and secondary message lines on the LID default screen (Fig. 17). These messages will indicate where the fault is occurring. The Alarm History table on the LID Service menu will also carry an alarm message to further expand on this alarm. For a complete listing of messages, see Table 10. If the alarm light starts to flash while accessing a menu screen, depress EXIT to return to the Default screen to read the failure message. The compressor will not run with an alarm condition existing, unless the alarm type is an unauthorized start or a failure to shut down.

Checking Temperature Sensors — All temperature sensors are of the thermistor type. This means that the resistance of the sensor varies with temperature. All sensors have the same resistance characteristics. Determine sensor temperature by measuring voltage drop if the controls are powered, or resistance if the controls are powered off. Compare the readings to the values listed in Tables 11 and 12.

RESISTANCE CHECK — Turn off the control power and disconnect the terminal plug of the sensor in question from the module. Measure sensor resistance between receptacles designated by the wiring diagram with a digital ohmmeter. The resistance and corresponding temperature is listed in Tables 11 and 12. Check the resistance of both wires to ground. This resistance should be infinite.

VOLTAGE DROP — Using a digital voltmeter, the voltage drop across any energized sensor can be measured while the control is energized. Tables 11 and 12 list the relationship between temperature and sensor voltage drop (volts dc measured across the energized sensor). Exercise care when measuring voltage to prevent damage to the sensor leads, connector plugs, and modules. Voltage should also be checked at the sensor plugs. Check the sensor wire at the sensor for 5 vdc if the control is powered.

⚠ CAUTION

Relieve all refrigerant pressure or drain the water prior to replacing the temperature sensors.

CHECK SENSOR ACCURACY — Place the sensor in a medium of a known temperature and compare that temperature to the measured reading. The thermometer used to determine the temperature of the medium should be of laboratory quality with 0.5 F (.25 C) graduations. The sensor in question should be accurate to within 2 F (1.2 C).

See Fig. 11 and 12 for sensor locations. The sensors are immersed directly in the refrigerant or water circuits. The wiring at each sensor is easily disconnected by unlatching the connector. These connectors allow only one-way connection to the sensor. When installing a new sensor, apply a pipe sealant or thread sealant to the sensor threads.

DUAL TEMPERATURE SENSORS — Two motor temperature sensors are provided for service convenience. In case one of the dual sensors is damaged, the other one can be used by moving a wire.

The number 1 terminal in the sensor terminal box is the common line. To use the second sensor, move the wire from the number 2 position to the number 3 position.

Checking Pressure Transducers — There are 3 pressure transducers on the 23XL. These determine cooler, discharge, and oil pressure. The PIC uses the discharge pressure transducer to determine condenser pressure. The PIC also determines refrigerant temperatures from cooler and condenser pressure. All 3 can be calibrated if necessary. It is not usually necessary to calibrate at initial start-up. However, at high altitude locations, calibration of the transducer will be necessary to ensure the proper refrigerant temperature/pressure relationship. Each transducer is supplied with 5 vdc power from a power supply. If the power supply fails, a transducer voltage reference alarm will occur. If the transducer reading is suspected of being faulty, check the supply voltage. It should be 5 vdc ± .5 v. If the supply voltage is correct, the transducer should be recalibrated or replaced.

Calibration can be checked by comparing the pressure readings from the transducer against an accurate refrigeration gage. These readings are all viewed or calibrated from the Status01 table on the LID. The transducer can be checked and calibrated at 2 pressure points. These calibration points are 0 psig (0 kPa) and 250 ± 10 psig (1724 ± 69 kPa). To calibrate these transducers:

1. Shut down the compressor.
2. Disconnect the transducer in question from its Schrader fitting.
3. Access the Status01 table, and view the particular transducer reading; it should read 0 psig (0 kPa). If the reading is not 0 psig (0 kPa), but within ± 5 psi (35 kPa), the value may be zeroed by pressing the SELECT softkey while the highlight bar is located on the transducer, and then by pressing the ENTER softkey.

If the transducer value does not move to 0 psig (0 kPa), the transducer will return to the original reading. If the pressure is within the allowed range, check the voltage ratio of the transducer. To obtain the voltage ratio, divide the voltage (dc) input from the transducer by the supply voltage signal, measured at the PSIO terminals J7-J34 and J7-J35. For example, the condenser transducer voltage input is measured at PSIO terminals J7-1 and J7-2. The voltage ratio must be between 0.80 vdc and 0.11 vdc for the software to allow calibration. Pressurize the transducer until the ratio is within range. Then attempt calibration again.

4. A high pressure point can also be calibrated between 240 and 260 psig (1655 and 1793 kPa) by attaching a regulated 250 psig (1724 kPa) pressure (usually from a nitrogen cylinder). The high pressure point can be calibrated by accessing the transducer on the Status01 table, highlighting the transducer, pressing the SELECT softkey, and then increasing or decreasing the value to the exact pressure on the refrigerant gage. Press ENTER to finish. High altitude locations must compensate the pressure so that the temperature/pressure relationship is correct.

   If the transducer reading returns to the previous value and the pressure is within the allowed range, check the voltage ratio of the transducer. Refer to Step 3 above. The voltage ratio for this high pressure calibration must be between 0.536 and 0.634 vdc to allow calibration. Change the pressure at the transducer until the ratio is within the acceptable range. Then attempt to calibrate to the new pressure input.

The PIC will not allow calibration if the transducer is too far out of calibration. A new transducer must be installed and re-calibrated.

TRANSDUCER REPLACEMENT — Since the transducers are mounted on Schrader-type fittings, there is no need to remove refrigerant from the vessel. Disconnect the transducer wiring by pulling up on the locking tab while pulling up on the weather-tight connecting plug from the end of the transducer. *Do not pull on the transducer wires.* Unscrew the transducer from the Schrader fitting. When installing a new transducer, do not use pipe sealer, which can plug the sensor. Put the plug connector back on the sensor and snap into place. Check for refrigerant leaks.

⚠ WARNING

Make sure to use a backup wrench on the Schrader fitting whenever removing a transducer.

Control Algorithms Checkout Procedure — In the LID Service menu, one of the tables is Control Algorithm Status. This table contains 4 maintenance tables which may be viewed in order to see how the particular control algorithm is operating. The 4 tables are:

MAINT01	Capacity Control	This table shows all values that are used to calculate the chilled water/brine control point.
MAINT02	Override Status	Details of all chilled water control override values are viewed here.
MAINT03	HGBP Status	The hot gas bypass control algorithm status is viewed from this screen. All values dealing with this control are displayed.
MAINT04 (PSIO Software Version 13 and higher)	LEAD/LAG STATUS	This table shows the condition of LEAD/LAG operation.
OCCDEFM	Time Schedules Status	The Local and CCN occupied schedules are displayed here in a manner that the operator can quickly determine whether the schedule is in the OCCUPIED mode or not.

These maintenance tables are very useful in determining how the control temperature is calculated, slide valve positioning reaction from load changes, control point overrides, hot gas bypass reaction, etc.

Control Test — The Control Test feature can check all of the thermistor temperature sensors, including those on the Options modules, pressure transducers, pumps and their associated flow switches, slide valve assembly, and other control outputs, such as hot gas bypass. The test can help to determine whether a switch is defective, or a pump relay is not operating, among other troubleshooting tests. During pumpdown operations, the pumps are energized to prevent freeze-up and the vessel pressures and temperatures are displayed. The lockout feature will prevent start-up of the compressor when no refrigerant is present in the machine, or if the vessels are isolated. The lockout is then terminated by the operator by using the Terminate Lockout function after the pumpdown procedure is reversed and refrigerant is added.

LEGEND FOR TABLE 10, A - N

1CR__AUX	— 1CR Compressor Start Contact	**OILP**	— Oil Pressure
CA__P	— Compressor Current	**OILPD**	— Oil Pressure Differential
CDFL	— Condenser Water Flow	**OILSS**	— Oil Level Switch
CHIL__S__S	— Chiller Start/Stop	**OILT**	— Oil Temperature
CHWS	— Chiller Water Supply	**PIC**	— Product Integrated Control
CHWR	— Chiller Water Return	**PRS__TRIP**	— High Condenser Pressure Trip Switch
CMPD	— Compressor Discharge Temperature	**PSIO**	— Processor Sensor Input/Output Module
CR__AUX	— 1CR Compressor Start Contact	**RLA**	— Rated Load Amps
CRP	— Condenser Refrigerant Pressure	**RUN__AUX**	— Compressor Run Contact
CRT	— Condenser Temperature	**SPR__PL**	— Spare Protective Limit Input
DEM__LIM__	— Demand Limit	**SMM**	— Starter Management Module
ERT	— Evaporator Refrigerant Temperature	**STR__FLT**	— Starter Fault
EVFL	— Evaporator Water Flow	**SV__MAN**	— Manual Slide Valve
LID	— Local Interface Device	**V__P**	— Line Voltage
MTRW	— Motor Winding Temperature	**V__REF**	— Voltage Reference

Table 10 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides

A. SHUTDOWN WITH ON/OFF/RESET-OFF

PRIMARY MESSAGE	SECONDARY MESSAGE	PROBABLE CAUSE/REMEDY
MANUALLY STOPPED — PRESS	CCN OR LOCAL TO START	PIC in OFF mode; press the CCN or local soft key to start unit.
TERMINATE PUMPDOWN MODE	TO SELECT CCN OR LOCAL	Enter the Control Test menu and select Terminate Lockout to unlock compressor, and place in OFF mode.
SHUTDOWN IN PROGRESS	COMPRESSOR UNLOADING	Machine unloading before shutdown due to soft stop feature.
SHUTDOWN IN PROGRESS	COMPRESSOR DEENERGIZED	Machine compressor is being commanded to stop. Water pumps are deenergized within one minute.
ICE BUILD	OPERATION COMPLETE	Machine shutdown from Ice Build operation.

B. TIMING OUT OR TIMED OUT

PRIMARY MESSAGE	SECONDARY MESSAGE	PROBABLE CAUSE/REMEDY
READY TO START IN XX MIN	UNOCCUPIED MODE	Time schedule for PIC is unoccupied. Machines will start only when occupied.
READY TO START IN XX MIN	REMOTE CONTACTS OPEN	Remote contacts have stopped machine. Close contacts to start.
READY TO START IN XX MIN	STOP COMMAND IN EFFECT	Chiller START/STOP on Status01 manually forced to stop. Release value to start.
READY TO START IN XX MIN	RECYCLE RESTART PENDING	Machine in recycle mode.
READY TO START	UNOCCUPIED MODE	Time schedule for PIC is UNOCCUPIED. Machine will start when occupied.
READY TO START	REMOTE CONTACTS OPEN	Remote contacts have stopped machine. Close contacts to start.
READY TO START	STOP COMMAND IN EFFECT	Chiller START/STOP on Status01 manually forced to stop. Release value to start.
READY TO START IN XX MIN	REMOTE CONTACTS CLOSED	Machine timer counting down unit. Ready for start.
READY TO START IN XX MIN	OCCUPIED MODE	Machine timer counting down unit. Ready for start.
READY TO START	REMOTE CONTACTS CLOSED	Machine timers complete, unit start will commence.
READY TO START	OCCUPIED MODE	Machine timers complete, unit start will commence.
STARTUP INHIBITED	LOADSHED IN EFFECT	CCN loadshed module commanding chiller to stop.
READY TO START IN XX MIN	START COMMAND IN EFFECT	Chiller START/STOP on Status01 has been manually forced to start. Machine will start regardless of time schedule or remote contact status.

C. IN RECYCLE SHUTDOWN

PRIMARY MESSAGE	SECONDARY MESSAGE	PROBABLE CAUSE/REMEDY
RECYCLE RESTART PENDING	OCCUPIED MODE	Unit in recycle mode, chilled water temperature is not high enough to start.
RECYCLE RESTART PENDING	REMOTE CONTACT CLOSED	Unit in recycle mode, chilled water temperature is not high enough to start.
RECYCLE RESTART PENDING	START COMMAND IN EFFECT	Chiller START/STOP on Status01 manually forced to start, chilled water temperature is not high enough to start.
RECYCLE RESTART PENDING	ICE BUILD MODE	Machine in ICE BUILD mode. Chilled water/brine temperature is satisfied for ice build set point temperature.

Table 10 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

D. PRE-START FAILURES

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
PRESTART ALERT	STARTS LIMIT EXCEEDED	STARTS EXCESSIVE Compressor Starts (8 in 12 hours)	Depress the reset softkey if additional start is required.
PRESTART ALERT	HIGH MOTOR TEMPERATURE	MTRW VALUE exceeded limit of [LIMIT]*. Check motor temperature.	Check motor cooling line for proper operation. Check for excessive starts within a short time span.
PRESTART ALERT	OIL PRESS./LEVEL SAFETY	OILSS check oil level in sump.	Check for low oil level. Check oil level switch operation.
PRESTART ALERT	HIGH DISCHARGE TEMP	CMPD VALUE exceeded limit of [LIMIT]*. Check condenser temperature.	Check sensor accuracy.
PRESTART ALERT	LOW REFRIGERANT TEMP	ERT VALUE exceeded limit of [LIMIT]*. Check refrigerant temperature.	Check transducer accuracy. Check for low chilled water/brine supply temperature.
PRESTART ALERT†	LOW OIL TEMPERATURE	OILT VALUE exceeded limit of [LIMIT]*. Check oil temperature.	Check oil heater power under oil sump temperature control (see page 29), oil heater relay.
PRESTART ALERT	LOW LINE VOLTAGE	V__ P VALUE exceeded limit of [LIMIT]*. Check voltage supply.	Check voltage supply. Check voltage transformers. Consult power utility if voltage is low.
PRESTART ALERT	HIGH LINE VOLTAGE	V__ P VALUE exceeded limit of [LIMIT]*. Check voltage supply.	Same as above.
PRESTART ALERT	LOADSHED/RED LINE ACTIVE	DEM__LIM Redline and/or Loadshed active.	Check Loadshed function on Config table is disabled. Send a Cancel Redline or Cancel Loadshed command. Check MAXIMUM LOADSHED TIME has elapsed.
PRESTART ALERT	HIGH CONDENSER PRESSURE	CRP VALUE exceeded limit of [LIMIT]*. Check condenser water and transducer.	Check for high condenser water temperature. Check transducer accuracy.

*[LIMIT] is shown on the LID as temperature, pressure, voltage, etc., predefined or selected by the operator as an override or an alert.
†Applicable to Frame 1 and 2 machines only.

E. NORMAL OR AUTO.-RESTART

PRIMARY MESSAGE	SECONDARY MESSAGE	STATUS
STARTUP IN PROGRESS	OCCUPIED MODE	Machine starting. Time schedule is occupied.
STARTUP IN PROGRESS	REMOTE CONTACT CLOSED	Machine starting. Remote contacts are closed.
STARTUP IN PROGRESS	START COMMAND IN EFFECT	Machine starting. Chiller START/STOP on Status01 manually forced to start.
AUTORESTART IN PROGRESS	OCCUPIED MODE	Machine starting. Time schedule is occupied.
AUTORESTART IN PROGRESS	REMOTE CONTACT CLOSED	Machine starting. Remote contacts are closed.
AUTORESTART IN PROGRESS	START COMMAND IN EFFECT	Machine starting. Chiller START/STOP on Status01 manually forced to start.

Table 10 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

F. START-UP FAILURES

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
FAILURE TO START	NO OIL PRESSURE	OILPD VALUE exceeded limit of [LIMIT]*. Check oil filter, oil solenoid or shutoff valve.	Check solenoid valve operation. Check for closed oil supply valves. Check oil filter. Check for low oil temperature. Check transducer accuracy. Check oil supply valves, oil filter, low oil temperature, transducer accuracy, entering condenser water temperature, and hot gas bypass.
FAILURE TO START	OIL PRESS SENSOR FAULT	OILP Check oil pressure transducer.	Check for excessive refrigerant in oil sump. Check transducer for power supply. Check wiring. Replace transducer if necessary.
FAILURE TO START	LOW CHILLED WATER FLOW	EVFL Evap Flow Fault: Check water pump/ flow switch.	Verify chilled water flow. Make sure pump is operating properly. Check wiring to flow switch. Check through controls test for proper switch operation.
FAILURE TO START	LOW CONDENSER WATER FLOW	CDFL Cond. Flow Fault: Check water pump/flow switch.	Same as above.
FAILURE TO START	STARTER FAULT	STR__FLT Starter Fault: Check Starter for Fault Source.	Starter fault switch has opened. Check starter for ground fault, voltage trip, temperature trip, etc.
FAILURE TO START	STARTER OVERLOAD TRIP	STR__FLT Starter Overload Trip: Check amps calibration/reset overload.	Reset overloads before restart. Check motor current calibration.
FAILURE TO START	LINE VOLTAGE DROPOUT	V__P Single-Cycle Dropout Detected: Check voltage supply.	Check voltage supply. Check transformers for supply. Check with utility if voltage supply is erratic. Monitor must be installed to confirm consistent, single-cycle dropouts.
FAILURE TO START	HIGH CONDENSER PRESSURE	CRP High Condenser Pressure: Check switch and water temp/flow.	Check for proper design condenser flow and temperature. Check condenser approach. Check 2C auxiliary contacts.
FAILURE TO START	EXCESS ACCELERATION TIME	CA__P Excess Acceleration: Check slide valve closure at start-up.	Check that slide valve is opened at start-up. Check starter for proper operation. Reduce unit pressure if possible. Check power supply.
FAILURE TO START	STARTER TRANSITION FAULT	RUN__AUX Starter Transition Fault: Check 1CR/1M/Interlock mechanism	Check starter for proper operation. Run contact failed to close.
FAILURE TO START	1CR AUX CONTACT FAULT	CR__AUX Starter Contact Fault: Check 1CR/1M aux. contacts.	Check starter for proper operation. Start contact failed to close.
FAILURE TO START	MOTOR AMPS NOT SENSED	CA__P Motor Amps Not Sensed: Check motor load signal.	Check for proper motor amps signal to SMM.
FAILURE TO START	MOTOR WIRING INCORRECT	Check motor wiring for phase reversal.	Check incoming power leads to starter.
FAILURE TO START	LOW OIL PRESSURE	OILPD VALUE exceeded limit of [LIMIT]. Check oil system, oil solenoid and transducer.	Minimum oil pressure requirement was not met during the first 120 seconds of start-up. Check entering condenser water temperature requirement. See Table 1.
FAILURE TO START	CHECK REFRIGERANT TYPE	STARTUP TERMINATED: Check refrigerant type	Check for proper refrigerant configuration.

*[LIMIT] is shown on the LID as temperature, pressure, voltage, etc., predefined or selected by the operator as an override or an alert.

Table 10 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

G. COMPRESSOR JUMPSTART AND REFRIGERANT PROTECTION

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/ PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
UNAUTHORIZED OPERATION	UNIT SHOULD BE STOPPED	CA__P Emergency: Compressor running without control authorization.	Compressor is running with more than 10% RLA and control is trying to shut it down. Throw power off to compressor if unable to stop. Determine cause before repowering.
POTENTIAL FREEZE-UP	EVAP PRESS/TEMP TOO LOW	ERT Emergency: Freeze-up prevention.	Determine cause. If pumping refrigerant out of machine, stop operation and go over pumpout procedures.
FAILURE TO STOP	DISCONNECT POWER	RUN__AUX Emergency: DISCONNECT POWER.	Starter and run and start contacts are energized while control tried to shut down. Disconnect power to starter.
LOSS OF COMMUNICATION	WITH STARTER	Loss of Communication with Starter: Check machine.	Check wiring from PSIO to SMM. Check SMM module troubleshooting procedures.
STARTER CONTACT FAULT	ABNORMAL 1CR OR RUN AUX	CR__AUX Starter Contact Fault: Check 1CR/1M aux. contacts.	Starter run and start contacts energized while machine was off. Disconnect power.
POTENTIAL FREEZE-UP	COND PRESS/TEMP TOO LOW	CRT Emergency: Freeze-up prevention.	The condenser pressure transducer is reading a pressure that could freeze the water in the condenser tubes. Check for condenser refrigerant leaks, bad transducers, or transferred refrigerant. Place unit in Pumpdown mode to eliminate ALARM if vessel is evacuated.

H. NORMAL RUN WITH RESET, TEMPERATURE, OR DEMAND

PRIMARY MESSAGE	SECONDARY MESSAGE	PROBABLE CAUSE/REMEDY
RUNNING — RESET ACTIVE	4-20MA SIGNAL	Reset program active based upon CONFIG table set-up.
RUNNING — RESET ACTIVE	REMOTE SENSOR CONTROL	
RUNNING — RESET ACTIVE	CHW TEMP DIFFERENCE	
RUNNING — TEMP CONTROL	LEAVING CHILLED WATER	Default method of temperature control.
RUNNING — TEMP CONTROL	ENTERING CHILLED WATER	ECW control activated on CONFIG table.
RUNNING — TEMP CONTROL	TEMPERATURE RAMP LOADING	Ramp loading in effect. Use Service1 table to modify.
RUNNING — DEMAND LIMITED	BY DEMAND RAMP LOADING	Ramp loading in effect. Use Service1 table to modify.
RUNNING — DEMAND LIMITED	BY LOCAL DEMAND SETPOINT	Demand limit set point is < actual demand.
RUNNING — DEMAND LIMITED	BY 4-20MA SIGNAL	Demand limit is active based on CONFIG table set-up.
RUNNING — DEMAND LIMITED	BY CCN SIGNAL	
RUNNING — DEMAND LIMITED	BY LOADSHED/REDLINE	
RUNNING — TEMP CONTROL	HOT GAS BYPASS	Hot Gas Bypass is energized. See surge prevention in the control section.
RUNNING — DEMAND LIMITED	BY LOCAL SIGNAL	Active demand limit manually overridden or Status01 table.
RUNNING — TEMP CONTROL	ICE BUILD	Machine in Ice Build temperature control.

Table 10 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

I. NORMAL RUN OVERRIDES ACTIVE (ALERTS)

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
RUN CAPACITY LIMITED	HIGH CONDENSER PRESSURE	CRP VALUE exceeded limit of [LIMIT]*. Condenser pressure override.	See Capacity Overrides, Table 5. Correct operating condition.
RUN CAPACITY LIMITED	HIGH MOTOR TEMPERATURE	MTRW VALUE exceeded limit of [LIMIT]*. Motor temperature override.	
RUN CAPACITY LIMITED	LOW EVAP REFRIG TEMP	ERT VALUE exceeded limit of [LIMIT]*. Check refrigerant charge level.	
RUN CAPACITY LIMITED	MANUAL SLIDE VALVE	SV__MAN Run Capacity Limited: Manual slide valve control.	

*[LIMIT] is shown on the LID as temperature, pressure, voltage, etc., predefined or selected by the operator as an override or an alert.

J. OUT-OF-RANGE SENSOR FAILURES

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
SENSOR FAULT	LEAVING CHW TEMPERATURE	Sensor Fault: Check leaving CHW sensor.	See sensor test procedure and check sensors for proper operation and wiring.
SENSOR FAULT	ENTERING CHW TEMPERATURE	Sensor Fault: Check entering CHW sensor.	
SENSOR FAULT	CONDENSER PRESSURE	Sensor Fault: Check cond pressure transducer.	
SENSOR FAULT	EVAPORATOR PRESSURE	Sensor Fault: Check evap pressure transducer.	
SENSOR FAULT	MOTOR WINDING TEMP	Sensor Fault: Check motor temp sensor.	
SENSOR FAULT	ROTOR INLET TEMPERATURE	Sensor Fault: Check rotor inlet temp sensor.	
SENSOR FAULT	OIL SUMP TEMPERATURE	Sensor Fault: Check oil sump temp sensor.	
SENSOR FAULT	OIL PRESSURE TRANSDUCER	Sensor Fault: Check oil pressure transducer.	

K. MACHINE PROTECT LIMIT FAULTS

⚠ WARNING

Excessive numbers of the same fault can lead to severe machine damage. Seek service expertise.

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/ PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
PROTECTIVE LIMIT	HIGH DISCHARGE TEMP	CMPD VALUE exceeded limit of [LIMIT]*. Check oil temperature.	Check discharge temperature immediately. Check for sensor accuracy. Check for proper condenser flow and temperature, check oil sump temperature. Check condenser for fouled tubes or air in machine.
PROTECTIVE LIMIT	LOW REFRIGERANT TEMP	ERT VALUE exceeded limit of [LIMIT]*. Check evap pump and flow switch.	Check for proper amount of refrigerant charge, check for proper water flow and temperatures. Check for proper slide valve operation.
PROTECTIVE LIMIT	HIGH MOTOR TEMPERATURE	MTRW VALUE exceeded limit of [LIMIT]*. Check motor cooling.	Check motor temperature immediately. Check sensor for accuracy. Check for proper condenser flow and temperature. Check motor cooling system for restrictions. Check refrigerant filter.
PROTECTIVE LIMIT	OIL LEVEL SENSOR	OILSS check oil level in separator.	Check for low oil level. Check oil level switch operation.
PROTECTIVE LIMIT	LOW OIL PRESSURE	OILPD VALUE exceeded limit of [LIMIT]*. Check oil system, oil solenoid, and transducer.	Check oil level, check for dirty filter. Check tower water temperature.
PROTECTIVE LIMIT	NO MOTOR CURRENT	CA__P Loss of Motor Current: Check sensor and signal.	Check wiring: Check torque setting on solid state starter. Check for main circuit breaker trip. Check power supply to PSIO module.
PROTECTIVE LIMIT	POWER LOSS	V__P Power Loss: Check voltage supply.	Check 24-vdc input sensor on the SMM; adjust potentiometer if necessary. Check transformers to SMM. Check distribution bus. Consult power company.
PROTECTIVE LIMIT	LOW LINE VOLTAGE	V__P VALUE exceeded limit of [LIMIT]*. Check voltage supply.	
PROTECTIVE LIMIT	HIGH LINE VOLTAGE	V__P VALUE exceeded limit of [LIMIT]*. Check voltage supply.	
PROTECTIVE LIMIT	LOW CHILLED WATER FLOW	EVFL Flow Fault: Check evap. pump/flow switch.	Perform pumps control test and verify proper switch operation. Check all water valves and pump operation.
PROTECTIVE LIMIT	LOW CONDENSER WATER FLOW	CDFL Flow Fault: Check cond. pump/flow switch.	
PROTECTIVE LIMIT	HIGH CONDENSER PRESSURE	PRS__TRIP High Condenser Pressure: Check switch and water temp/flow.	Condenser pressure transducer tripped machine. Check for proper condenser water flows and temperature. Check high-pressure switch.
PROTECTIVE LIMIT	HIGH CONDENSER PRESSURE	CRP VALUE exceeded limit of [LIMIT]*. Check condenser water and transducer.	Check discharge pressure switch. Check for proper condenser flow and temperature. Check for fouled tubes.
PROTECTIVE LIMIT	1CR AUX CONTACT FAULT	CR__AUX Starter Contact Fault: Check 1CR/1M aux contacts.	1CR auxiliary contact opened while machine was running. Check starter for proper operation.
PROTECTIVE LIMIT	RUN AUX CONTACT FAULT	RUN__AUX Starter Contact Fault: Check 1CR/1M aux contacts.	Run auxiliary contact opened while machine was running. Check starter for proper operation.
PROTECTIVE LIMIT	CCN OVERRIDE STOP	CHIL__S__S CCN Override Stop while in LOCAL run mode.	CCN has signaled machine to stop. Reset and restart when ready. If the signal was sent by the LID, release the Stop signal on STATUS01 screen.
PROTECTIVE LIMIT	SPARE SAFETY DEVICE	SRP__PL Spare Safety Fault: Check contacts.	Spare safety input has tripped or factory-installed jumper not present.
PROTECTIVE LIMIT	EXCESSIVE MOTOR AMPS	CA__P VALUE exceeded limit of [LIMIT]*. High Amps; Check slide valve.	Check motor current for proper calibration. Check slide valve for proper operation.
PROTECTIVE LIMIT	STARTER FAULT	STR__FLT Starter Fault: Check starter for fault source.	Check starter for possible ground fault, reverse rotation, voltage trip, etc.
PROTECTIVE LIMIT	STARTER OVERLOAD TRIP	STR__FLT Starter Overload Trip: Check amps calibration/ reset overload.	Reset overloads and reset alarm. Check motor current calibration or overload calibration (do not field-calibrate overloads).
PROTECTIVE LIMIT	TRANSDUCER VOLTAGE FAULT	V__REF VALUE exceeded limit of [LIMIT]*. Check transducer power supply.	Check transformer power (5 vdc) supply to transducers. Power must be 4.5 to 5.5 vdc.
PROTECTIVE LIMIT	DIRTY OIL FILTER	OILP exceeded limit of [LIMIT]*. Replace oil filter.	Check oil filter. Check solenoid valve operation. Check oil supply valves. Check discharge and oil transducer accuracy.
PROTECTIVE UNIT†	LOW DISCHARGE SUPERHEAT	Low discharge superheat. Check refrigerant and oil charges.	Excessive oil/refrigerant charge, low load operation. Reclaim oil lost to refrigerant circuit; remove excess oil. Do not operate machine below minimum load. Check tower control operation.

*[LIMIT] is shown on the LID as temperature, pressure, voltage, etc., predefined or selected by the operator as an override or an alert.
†Applicable to Frame 1 and 2 units only.

Table 10 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

L. MACHINE ALERTS

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/ PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
RECYCLE ALERT	HIGH AMPS AT SHUTDOWN*	High Amps at Recycle: Check slide valve.	Check that slide valve is opening. Check motor amps correction calibration is correct.
SENSOR FAULT ALERT	LEAVING COND WATER TEMP	Sensor Fault: Check leaving condenser water sensor.	Check sensor: See sensor test procedure.
SENSOR FAULT ALERT	ENTERING COND WATER TEMP	Sensor Fault: Check entering condenser water sensor.	
DIRTY OIL FILTER ALERT	HIGH OIL PRESSURE DROP	Replace oil filter.	Condenser pressure minus oil filter pressure alert greater than oil pressure transducer. Reconfigure oil filter pressure alert on Service1 or change oil filter.
AUTORESTART PENDING	POWER LOSS	V__P Power Loss: Check voltage supply.	Check power supply if there are excessive compressor starts occuring.
AUTORESTART PENDING	LOW LINE VOLTAGE	V__P VALUE exceeded limit of [LIMIT]†. Check voltage supply.	
AUTORESTART PENDING	HIGH LINE VOLTAGE	V__P VALUE exceeded limit of [LIMIT]†. Check voltage supply.	
SENSOR ALERT	HIGH DISCHARGE TEMP	CMPD VALUE exceeded limit of [LIMIT]†. Check oil temperature.	Discharge temperature exceeded the alert threshold. Check entering condenser water temperature.
SENSOR ALERT	LOW OIL PRESSURE	OILPD VALUE exceeded limit of [LIMIT]†. Low oil pressure alert.	Check that oil pressure transducer and/or evaporator pressure transducer are not out of range. Check entering condenser water temperature.
CONDENSER PRESSURE ALERT	PUMP RELAY ENERGIZED	CRP High Condenser Pressure, [VALUE] Pump energized to reduce pressure.	Check ambient conditions. Check condenser pressure for accuracy.
RECYCLE ALERT	EXCESSIVE RECYCLE STARTS	EXCESSIVE RECYCLE STARTS	The machine load is too small to keep the machine on line. More than 5 restarts have occurred in 4 hours. Increase machine load, adjust hot gas bypass, increase RECYCLE RESTART DELTA T temperature. Do not start chiller until minimum load is available.
POTENTIAL FREEZE-UP	COND PRESS/TEMP TOO LOW	CONDENSER freeze-up protection.	Check condenser water pump operation. Refer to Condenser Freeze Protection section on page 31.

*Only applicable PSIO Software Version 13 and lower.

†[LIMIT] is shown on the LID as temperature, pressure, voltage, etc., predefined or selected by the operator as an override or an alert.

M. SPARE SENSOR ALERT MESSAGES

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/ PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
SPARE SENSOR ALERT	COMMON CHWS SENSOR	Sensor Fault: Check common CHWS sensor.	Check alert temperature set points on Equipment Service Service2 LID screen. Check sensor for accuracy if reading is not accurate.
SPARE SENSOR ALERT	COMMON CHWR SENSOR	Sensor Fault: Check common CHWR sensor.	
SPARE SENSOR ALERT	REMOTE RESET SENSOR	Sensor Fault: Check remote reset temperature sensor.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 1	Sensor Fault: Check temperature sensor — Spare 1.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 2	Sensor Fault: Check temperature sensor — Spare 2.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 3	Sensor Fault: Check temperature sensor — Spare 3.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 4	Sensor Fault: Check temperature sensor — Spare 4.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 5	Sensor Fault: Check temperature sensor — Spare 5.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 6	Sensor Fault: Check temperature sensor — Spare 6.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 7	Sensor Fault: Check temperature sensor — Spare 7.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 8	Sensor Fault: Check temperature sensor — Spare 8.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 9	Sensor Fault: Check temperature sensor — Spare 9.	

Table 10 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

N. ADDITIONAL TROUBLESHOOTING INFORMATION

DESCRIPTION	REMEDY
At power-up, default screen does not appear. Instead, "Uploading Tables" message continually appears.	Check for proper communications wiring on PSIO module. Check that the Level I communications wires are terminated to the Level I PSIO connection.
Blank LID screen.	Check red LED on LID (power supply) for proper operation. If LED is blinking, but green LEDs are not, replace LID module (memory failure).
Scrambled LID display screens.	Attach to the local PSIO bus/address on the Attach to Network Device table of the Service menu.
SMM communications failure.	Check that PSIO communication plugs are connected correctly. Check SMM communication plug. Check for proper SMM power supply. See Troubleshooting Guide on page 68. If battery was removed or battery terminals shorted, module has been erased; replace. Check that wire strands are not crossing over to other terminal pin connections.
"Communications Failure" highlighted message at bottom of LID.	LID is not properly addressed to the PSIO. Make sure that the Local Device on the Attach to Network Device table is set to read the PSIO bus/address. Check LEDs on PSIO. Is red LED operating properly? Are green LEDs blinking? See Troubleshooting Guide on page 68. If battery was removed or battery terminals shorted, module has been erased. Replace, if necessary.
"Control Test Disabled" message.	Press the STOP softkey. The PIC must be in the OFF mode for the Control Test to operate. Clear all alarms. Check line voltage percent on Status01 screen. The value must be within 90% to 110%. Check voltage input to SMM. Calibrate starter voltage potentiometer for accuracy.
Slide valve solenoid will not energize in Control Test.	Put machine into pumpdown mode or equalize the pressure. Check slide valve actuator solenoid wiring.
Pressure transducers will not calibrate.	At 0 psi (0 kPa), simply SELECT the transducer then press ENTER softkey. Pressing the INCREASE or DECREASE softkeys may cause calibration errors. Only use the INCREASE and DECREASE softkeys at the high pressure calibration point.
Pressure transducers are not reading correctly.	Schrader fittings can be installed too deep. Check that the transducer can fully depress the Schrader valve depressor pin. The top of the pin should be between .010 in. above the top of the valve body to .035 in. below the top of the valve body. Use a Schrader fitting installation tool.
Sensor reads −40 F (−40 C).	Indicates the loop is open. Check for proper connections and wire placement.
Nuisance high-pressure switch trips.	Check Schrader fitting on discharge pressure switch.
Discharge isolation valve appears to be installed backwards.	There is a small arrow on the discharge isolation valve which would normally indicate the direction of gas flow through the valve. However, the valve is correctly installed with the arrow pointing upward. This is because the better scaling surface is on the high pressure side which sees refrigerant pressure during shipment. During machine operation, flow through the valve will not be restricted and damage to the valve will not be incurred. Refrigerant can be isolated in the cooler since the valve operates reliably in either direction.
Refrigerant appears to be leaking through machine insulation.	Gas-off of insulation glue may activate a refrigerant leak detector.
Low megger reading on motor.	Liquid refrigerant will remain on bottom of motor housing. Terminal no. 3 will be submerged. May have as low as 1 to 2 megohm readings on terminal no. 3 and corresponding terminal no. 6 only. Check for power factor correction capacitors on starter.
Machine never comes out of UNOCCUPIED mode.	Configure time and date by selecting Time and Date from the Service menu.
Holiday Scheduling and Daylight Savings Time is not acknowledged.	The broadcast acknowledger on the Equipment Configuration BRODEFS table must be active. Only one broadcast acknowledger per communication network should be active.
Nuisance water/brine flow trips.	Check that flow switch contacts are gold plated. Recommended Delta-Pro switch comes preset to make at 2 psid. (14 kPad) It is possible to adjust this setting lower even though the specification states that 2 psid (14 kPad) is the lower limit. Turn the calibration set screw (counter) clockwise to (decrease) increase the acting.
Shutdown on low oil pressure at start-up.	Oil pressure created by system pressure differential. System pressure differential established by the difference between leaving condenser water temperature and leaving chilled water temperature. Minimum differential must exist between ECDW and LCW. Minimum ECDW at start-up is dependent on several factors (see Oil Cycle section). * Do not defeat machine control timers. Increase ramp loading rate. Open cooling tower bypass. Decrease flow rates. Check for dirty oil filter. Later machines include head pressure control poppet valve. Check that starter transition timer is set such that motor is up to full speed within 5 seconds. Check economizer back-pressure valve operation, if applicable. Check hot gas bypass ball valve.
Shutdown on low discharge superheat. (Applicable to Frame 1 and 2 machines only.)	Excessive oil charge. Refrigerant migration into oil causes oil to rise above baffle in separator, which results in oil floodback. Oil is lost to refrigerant circuit; cooler foams up; discharge temperature goes to zero superheat; wet discharge; diluted oil. Oil must be heated to 35 F (19 C) above evaporator refrigerant temperature to boil off excess refrigerant. Manually reclaim oil from refrigerant circuit. Remove excess oil. Machine will alarm or indicate low oil level if there was excess oil loss. Check refrigerant charge.
"Starter Fault" message.	Starter Fault switch on the front of the starter (if applicable) may be faulty. This Starter Fault switch only indicates a problem with transition. Other causes of Start Fault are ground fault, under/over voltage relays, and phase relays.
Compressor starts when starter is reset after alarm shutdown.	When a starter trip occurs, the SMM deliberately maintains its 24-v output to the 1CR relay for up to 10 seconds in order to determine the type of fault that has occurred.
Default screen readings are locked up while Status01 screen readings are fine.	Reset all alarms. Default screen reading freeze when an alarm occurs.
CHILLED WATER/BRINE temperature too high (machine running).	1. Chilled water set point set too high. Access set point on LID and verify. 2. Capacity override or excessive cooling load (machine at design capacity). Check LID status messages. Check for outside air infiltration into conditioned space. 3. Condenser temperature too high. Check for proper flow; examine cooling tower operation; check for air or water leaks. Check for fouled tubes. 4. Refrigerant level low. Check for leads. Add refrigerant. Trim charge. 5. Liquid bypass in waterbox. Examine division plates and gaskets for leaks. 6. Slide valve fails to close (load). Use Control Test to check operation. 7. Chilled water control point too high. Access Control Algorithm Status to check chilled water control operation. 8. Slide valve fails to close (load) fully. Be sure that the manual slide valve count is released. Check slide valve solenoids. Check that sensor is in the proper terminals.
CHILLED WATER/BRINE temperature too low (machine running).	1. Chilled water set point set too high. Access set point on LID and verify. 2. Chilled water control point too low. Access Control Algorithm Status table to check chilled water control for proper resets. 3. Slide valve fails to open (unload). Be sure that manual slide valve count is released. Check chilled water sensor accuracy. Check slide valve solenoids.
CHILLED WATER/BRINE temperature fluctuates; slide valve hunts.	1. Deadband too narrow. Configure LID for a larger deadband. 2. Proportional band too narrow. Either INC or DEC proportional bands should be widened. 3. Defective slide valve actuator. Check through Control Test. 4. Defective temperature sensor. Check sensor accuracy.
Kilowatt reading on Status01 table does not change during operation.	This feature is only active when the starter is provided with an optional 4-10 mA kW transducer wired to the SMM.

LEGEND

LED — Light-Emitting Diode
LID — Local Interface Device
PSIO — Processor Sensor Input/Output Module
SMM — Starter Management Module

*A field supplied, water temperature control system should be installed. The system should maintain the leaving condenser water temperature at a temperature that is 18 F (10 C) above the leaving chilled water temperature.

Table 11 — Thermistor Temperature (F) vs Resistance/Voltage Drop

TEMPERATURE (F)	VOLTAGE DROP (V)	RESISTANCE (OHMS)
−25.0	4.821	98010
−24.0	4.818	94707
−23.0	4.814	91522
−22.0	4.806	88449
−21.0	4.800	85486
−20.0	4.793	82627
−19.0	4.786	79871
−18.0	4.779	77212
−17.0	4.772	74648
−16.0	4.764	72175
−15.0	4.757	69790
−14.0	4.749	67490
−13.0	4.740	65272
−12.0	4.734	63133
−11.0	4.724	61070
−10.0	4.715	59081
−9.0	4.705	57162
−8.0	4.696	55311
−7.0	4.688	53526
−6.0	4.676	51804
−5.0	4.666	50143
−4.0	4.657	48541
−3.0	4.648	46996
−2.0	4.636	45505
−1.0	4.624	44066
0.0	4.613	42679
1.0	4.602	41339
2.0	4.592	40047
3.0	4.579	38800
4.0	4.567	37596
5.0	4.554	36435
6.0	4.540	35313
7.0	4.527	34231
8.0	4.514	33185
9.0	4.501	32176
10.0	4.487	31202
11.0	4.472	30260
12.0	4.457	29351
13.0	4.442	28473
14.0	4.427	27624
15.0	4.413	26804
16.0	4.397	26011
17.0	4.381	25245
18.0	4.366	24505
19.0	4.348	23789
20.0	4.330	23096
21.0	4.313	22427
22.0	4.295	21779
23.0	4.278	21153
24.0	4.258	20547
25.0	4.241	19960
26.0	4.223	19393
27.0	4.202	18843
28.0	4.184	18311
29.0	4.165	17796
30.0	4.145	17297
31.0	4.125	16814
32.0	4.103	16346
33.0	4.082	15892
34.0	4.059	15453
35.0	4.037	15027
36.0	4.017	14614
37.0	3.994	14214
38.0	3.968	13826
39.0	3.948	13449
40.0	3.927	13084
41.0	3.902	12730
42.0	3.878	12387
43.0	3.854	12053
44.0	3.828	11730
45.0	3.805	11416
46.0	3.781	11112
47.0	3.757	10816
48.0	3.729	10529
49.0	3.705	10250
50.0	3.679	9979
51.0	3.653	9717
52.0	3.627	9461
53.0	3.600	9213
54.0	3.575	8973
55.0	3.547	8739
56.0	3.520	8511
57.0	3.493	8291
58.0	3.464	8076
59.0	3.437	7868
60.0	3.409	7665
61.0	3.382	7468
62.0	3.353	7277
63.0	3.323	7091
64.0	3.295	6911
65.0	3.267	6735
66.0	3.238	6564
67.0	3.210	6399
68.0	3.181	6238
69.0	3.152	6081
70.0	3.123	5929
71	3.093	5781
72	3.064	5637
73	3.034	5497
74	3.005	5361
75	2.977	5229
76	2.947	5101
77	2.917	4976
78	2.884	4855
79	2.857	4737
80	2.827	4622
81	2.797	4511
82	2.766	4403
83	2.738	4298
84	2.708	4196
85	2.679	4096
86	2.650	4000
87	2.622	3906
88	2.593	3814
89	2.563	3726
90	2.533	3640
91	2.505	3556
92	2.476	3474
93	2.447	3395
94	2.417	3318
95	2.388	3243
96	2.360	3170
97	2.332	3099
98	2.305	3031
99	2.277	2964
100	2.251	2898
101	2.217	2835
102	2.189	2773
103	2.162	2713
104	2.136	2655
105	2.107	2597
106	2.080	2542
107	2.053	2488
108	2.028	2436
109	2.001	2385
110	1.973	2335
111	1.946	2286
112	1.919	2239
113	1.897	2192
114	1.870	2147
115	1.846	2103
116	1.822	2060
117	1.792	2018
118	1.771	1977
119	1.748	1937
120	1.724	1898
121	1.702	1860
122	1.676	1822
123	1.653	1786
124	1.630	1750
125	1.607	1715
126	1.585	1680
127	1.562	1647
128	1.538	1614
129	1.517	1582
130	1.496	1550
131	1.474	1519
132	1.453	1489
133	1.431	1459
134	1.408	1430
135	1.389	1401
136	1.369	1373
137	1.348	1345
138	1.327	1318
139	1.308	1291
140	1.291	1265
141	1.289	1240
142	1.269	1214
143	1.250	1190
144	1.230	1165
145	1.211	1141
146	1.192	1118
147	1.173	1095
148	1.155	1072
149	1.136	1050
150	1.118	1029
151	1.100	1007
152	1.082	986
153	1.064	965
154	1.047	945
155	1.029	925
156	1.012	906
157	0.995	887
158	0.978	868
159	0.962	850
160	0.945	832
161	0.929	815
162	0.914	798
163	0.898	782
164	0.883	765
165	0.868	750
166	0.853	734
167	0.838	719
168	0.824	705
169	0.810	690
170	0.797	677
171	0.783	663
172	0.770	650
173	0.758	638
174	0.745	626
175	0.734	614
176	0.722	602
177	0.710	591
178	0.700	581
179	0.689	570
180	0.678	561
181	0.668	551
182	0.659	542
183	0.649	533
184	0.640	524
185	0.632	516
186	0.623	508
187	0.615	501
188	0.607	494
189	0.600	487
190	0.592	480
191	0.585	473
192	0.579	467
193	0.572	461
194	0.566	456
195	0.560	450
196	0.554	445
197	0.548	439
198	0.542	434
199	0.537	429
200	0.531	424
201	0.526	419
202	0.520	415
203	0.515	410
204	0.510	405
205	0.505	401
206	0.499	396
207	0.494	391
208	0.488	386
209	0.483	382
210	0.477	377
211	0.471	372
212	0.465	367
213	0.459	361
214	0.453	356
215	0.446	350
216	0.439	344
217	0.432	338
218	0.425	332
219	0.417	325
220	0.409	318
221	0.401	311
222	0.393	304
223	0.384	297
224	0.375	289
225	0.366	282

Table 12 — Thermistor Temperature (C) vs Resistance/Voltage Drop

TEMPERATURE (C)	VOLTAGE DROP (V)	RESISTANCE (Ohms)
−40	4.896	168 230
−39	4.889	157 440
−38	4.882	147 410
−37	4.874	138 090
−36	4.866	129 410
−35	4.857	121 330
−34	4.848	113 810
−33	4.838	106 880
−32	4.828	100 260
−31	4.817	94 165
−30	4.806	88 480
−29	4.794	83 170
−28	4.782	78 125
−27	4.769	73 580
−26	4.755	69 250
−25	4.740	65 205
−24	4.725	61 420
−23	4.710	57 875
−22	4.693	54 555
−21	4.676	51 450
−20	4.657	48 536
−19	4.639	45 807
−18	4.619	43 247
−17	4.598	40 845
−16	4.577	38 592
−15	4.554	38 476
−14	4.531	34 489
−13	4.507	32 621
−12	4.482	30 866
−11	4.456	29 216
−10	4.428	27 633
−9	4.400	26 202
−8	4.371	24 827
−7	4.341	23 532
−6	4.310	22 313
−5	4.278	21 163
−4	4.245	20 079
−3	4.211	19 058
−2	4.176	18 094
−1	4.140	17 184
0	4.103	16 325
1	4.065	15 515
2	4.026	14 749
3	3.986	14 026
4	3.945	13 342
5	3.903	12 696
6	3.860	12 085
7	3.816	11 506
8	3.771	10 959
9	3.726	10 441
10	3.680	9 949
11	3.633	9 485
12	3.585	9 044
13	3.537	8 627
14	3.487	8 231
15	3.438	7 855
16	3.387	7 499
17	3.337	7 161
18	3.285	6 840
19	3.234	6 536
20	3.181	6 246
21	3.129	5 971
22	3.076	5 710
23	3.023	5 461
24	2.970	5 225
25	2.917	5 000
26	2.864	4 786
27	2.810	4 583
28	2.757	4 389
29	2.704	4 204
30	2.651	4 028
31	2.598	3 861
32	2.545	3 701
33	2.493	3 549
34	2.441	3 404
35	2.389	3 266
36	2.337	3 134
37	2.286	3 008
38	2.236	2 888
39	2.186	2 773
40	2.137	2 663
41	2.087	2 559
42	2.039	2 459
43	1.991	2 363
44	1.944	2 272
45	1.898	2 184
46	1.852	2 101
47	1.807	2 021
48	1.763	1 944
49	1.719	1 871
50	1.677	1 801
51	1.635	1 734
52	1.594	1 670
53	1.553	1 609
54	1.513	1 550
55	1.474	1 493
56	1.436	1 439
57	1.399	1 387
58	1.363	1 337
59	1.327	1 290
60	1.291	1 244
61	1.258	1 200
62	1.225	1 158
63	1.192	1 118
64	1.160	1 079
65	1.129	1 041
66	1.099	1 006
67	1.069	971
68	1.040	938
69	1.012	906
70	0.984	876
71	0.949	836
72	0.920	805
73	0.892	775
74	0.865	747
75	0.838	719
76	0.813	693
77	0.789	669
78	0.765	645
79	0.743	623
80	0.722	602
81	0.702	583
82	0.683	564
83	0.665	547
84	0.648	531
85	0.632	516
86	0.617	502
87	0.603	489
88	0.590	477
89	0.577	466
90	0.566	456
91	0.555	446
92	0.545	436
93	0.535	427
94	0.525	419
95	0.515	410
96	0.506	402
97	0.496	393
98	0.486	385
99	0.476	376
100	0.466	367
101	0.454	357
102	0.442	346
103	0.429	335
104	0.416	324
105	0.401	312
106	0.386	299
107	0.370	285

Control Modules

⚠ CAUTION

Turn controller power off before servicing controls. This ensures safety and prevents damage to controller.

The Processor module (PSIO), 8-input (Options) modules, Starter Management Module (SMM), and the Local Interface Device (LID) module perform continuous diagnostic evaluations of the hardware to determine its condition. Proper operation of all modules is indicated by LEDs (light-emitting diodes) located on the side of the LID, and on the top horizontal surface of the PSIO, SMM, and 8-input modules.

RED LED — If the LED is blinking continuously at a 2-second rate, it is indicating proper operation. If it is lit continuously, it indicates a problem requiring replacement of the module. If the red LED blinks 3 times per second, a software error has been discovered and the module should be replaced. Off continuously indicates that the power should be checked. If there is no input power, check fuses and the circuit breaker. If fuse is good, check for shorted secondary of transformer Or, if power is present to the module, replace the module.

GREEN LEDs — There are one or 2 green LEDs on each type of module. These LEDs indicate communication status between different parts of the controller and the network modules as follows:

LID Module

Upper LED — Communication with CCN network, if present; blinks when communication occurs.

Lower LED — Communication with PSIO module; must blink every 3 to 5 seconds.

PSIO Module

Green LED closest to communications connection — Communication with SMM and 8-input module; must blink continuously.

Other Green LED — Communication with LID. This green LED must blink every 3 to 5 seconds.

8-Input Modules and SMM

Green LED — Communication with PSIO module. This green LED will blink continuously.

Notes on Module Operation

1. The machine operator monitors and modifies configurations in the microprocessor through the 4 softkeys and the LID. Communication with the LID and the PSIO is accomplished through the CCN (Level II) bus. The communication between the PSIO, SMM, and both 8-input modules is accomplished through the sensor bus, which is a 3-wire cable. This sensor bus runs in parallel between modules.

   On sensor bus terminal strips, Terminal 1 of PSIO module is connected to Terminal 1 of each of the other modules. Terminals 2 and 3 are connected in the same manner. See Fig. 44-47. If a Terminal 2 wire is connected to Terminal 1, the system does not work.

2. If a green LED is solid on, check communication wiring. If a green LED is off, check the red LED. If the red LED is normal, check the module address switches (Fig. 44-47). Proper addresses are:

MODULE	ADDRESS	
	SW1	SW2
LID (Local Interface Device)	E	6
PSIO (Processor Sensor, Input/Output Module)	5	A
SMM (Starter Management Module)	3	2
8-input Options Module 1	6	4
8-input Options Module 2	7	2

   If all modules indicate communications failure, check communications plug on the PSIO module for proper seating. Also check the wiring terminations (Level II — 1:red, 2:wht, 3:blk; Sensor bus — 1:red, 2:blk, 3:clr/wht). If a good connection is assured and the condition persists, perform an Attach to Network Device upload of the PSIO module. The correct PSIO module address must be known to perform this function if the Attach to Network Device selection is not functioning, replace the module.

   If only one 8-input module or SMM indicates communication failure, check the communications plug on that module. Make sure wiring is properly connected. Communications plug must be connected to the correct socket. If a good connection is assured and the condition persists, replace the module.

   All system operating intelligence rests in the PSIO module. Some safety shutdown logic resides in the SMM in case communications are lost between the 2 modules. The PSIO monitors conditions using input ports on the PSIO, the SMM, and the 8-input modules. Outputs are controlled by the PSIO and SMM as well.

3. Power is supplied to modules within the control panel via 21-vac power sources.

   The transformers are located within the power panel, with the exception of the SMM, which operates from a 24-vac power source and has its own 24-vac transformer located within the starter.

   Within the power panel, T1 supplies power to the LID, the PSIO, and the 5-vac power supply for the transducers. The other 21-vac transformer is T4, which supplies power to both 8-input modules (if present). T4 is capable of supplying power to two modules; if additional modules are added, another power supply will be required.

   Power is connected to Terminals 1 and 2 of the power input connection on each module.

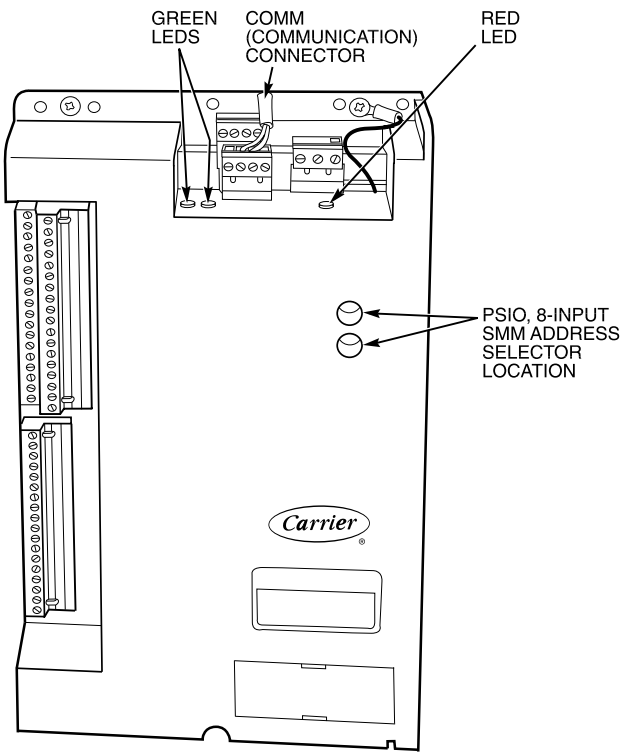
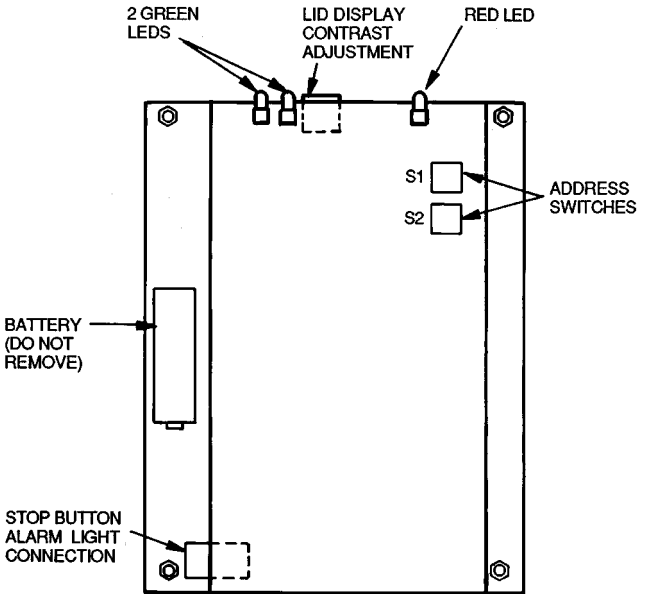


Fig. 44 — PSIO Module Address Selector Switch Locations and LED Locations



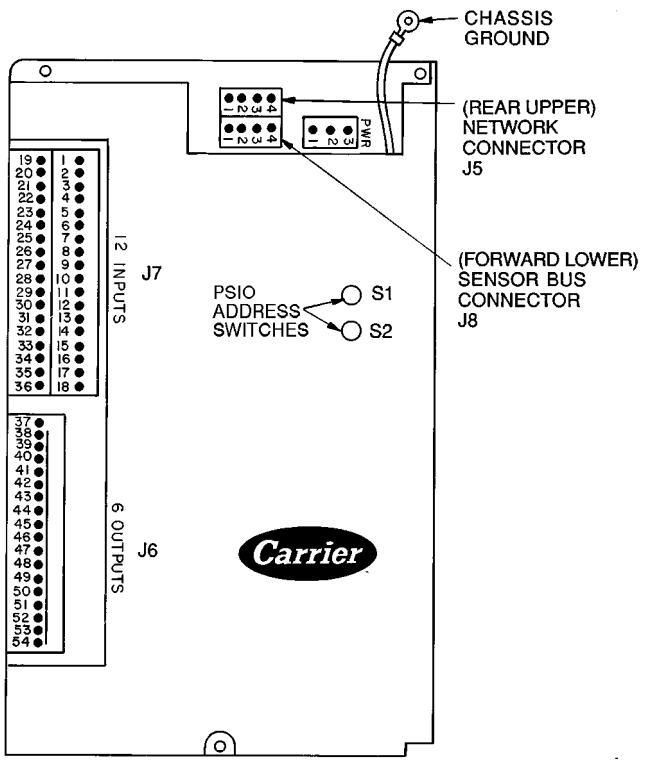
NOTE: LID address switches are factory set as follows: S1 is set at E; S2 is set at 6.

Fig. 45 — LID Module and Address Selector Switch Locations (Rear View) and LED Locations

Processor Module (PSIO) (Fig. 46)

INPUTS — Each input channel has 3 terminals; only 2 of the terminals are used. Application of machine determines which terminals are normally used. Always refer to individual unit wiring for terminal numbers.

OUTPUTS — Output is 20 vdc. There are 3 terminals per output, only 2 of which are used, depending on application. Refer to unit wiring diagram.



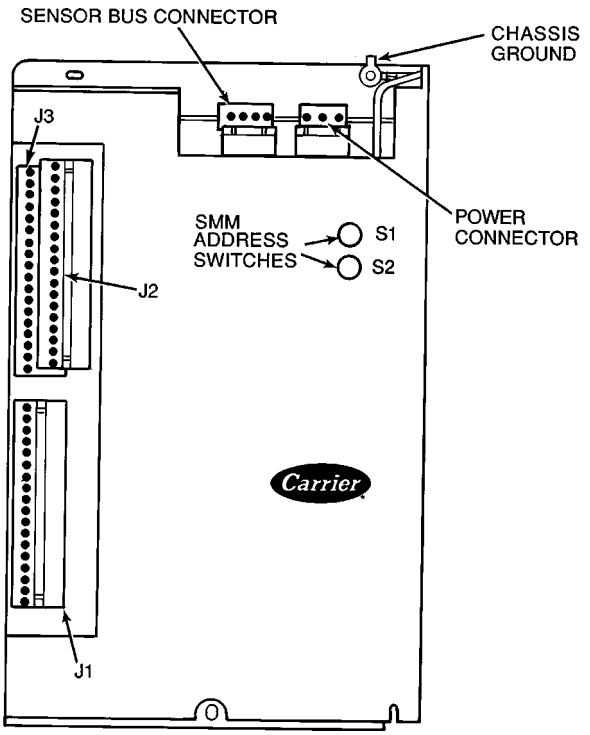
NOTE: PSIO address switches are factory set as follows: S1 is set at 5; S2 is set at A.

Fig. 46 — Processor (PSIO) Module

Starter Management Module (SMM) (Fig. 47)

INPUTS — Inputs on strips J2 and J3 are a mix of analog and discrete (on/off) inputs. Application of the machine determines which terminals are used. Always refer to the individual unit's wiring for terminal numbers.

OUTPUTS — Outputs are 24 vdc and wired to strip J1. There are 2 terminals used per output.



NOTE: SMM address switches should be set as follows: S1 set at 3; S2 set at 2.

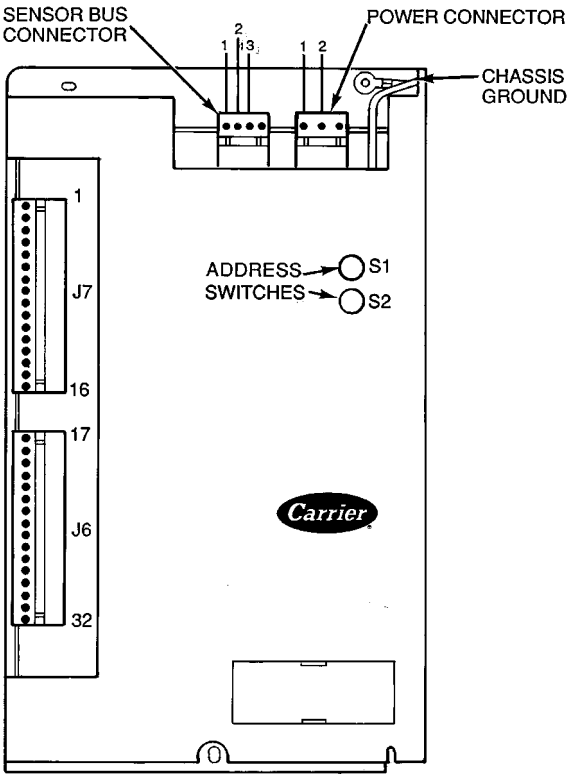
Fig. 47 — Starter Management Module (SMM)

Options Modules (8-input) — The Options modules are optional additions to the PIC, and are used to add temperature reset inputs, spare sensor inputs, and demand limit inputs. Each option module contains 8 inputs, each input meant for a specific duty. See the wiring diagram for exact module wire terminations. Inputs for each of the options modules available include the following:

OPTION MODULE 1
4 to 20 mA Auto. Demand Reset
4 to 20 mA Auto. Chilled Water Reset
Common Chilled Water Supply Temperature
Common Chilled Water Return Temperature
Remote Temperature Reset Sensor
Spare Temperature 1
Spare Temperature 2
Spare Temperature 3

OPTION MODULE 2
4 to 20 mA Spare 1
4 to 20 mA Spare 2
Spare Temperature 4
Spare Temperature 5
Spare Temperature 6
Spare Temperature 7
Spare Temperature 8
Spare Temperature 9

Terminal block connections are provided on the options modules. All sensor inputs are field wired and installed. Options module number 1 can be factory or field installed. Options module 2 is shipped separately and must be field installed. For installation, refer to unit or field wiring diagrams. Be sure to address the module for the proper module number (Fig. 48) and to configure the chiller for each feature being used.



NOTE: Options module address switches should be set as follows:

SWITCH SETTING	OPTION MODULE 1	OPTION MODULE 2
S1	6	7
S2	4	2

Fig. 48 — Options Module

Replacing Defective Processor Modules — The replacement part number is printed in a small label on front of the PSIO module. The model and serial numbers are printed on the unit nameplate located on an exterior corner post. The proper software is factory installed by Carrier in the replacement module. When ordering a replacement processor module (PSIO), specify complete replacement part number, full unit model number, and serial number. This new unit requires reconfiguration to the original machine's data by the installer.

⚠ CAUTION

Electrical shock can cause personal injury. Disconnect all electrical power before servicing.

INSTALLATION

1. Verify if the existing PSIO module is defective, by using the procedure described in the Troubleshooting Guide section, page 68, and Control Modules section, page 80. Do not select the Attach to Network Device from the service menu if the LID displays communication failure.
2. Data regarding the PSIO configuration should have been recorded and saved. This data will have to be reconfigured into the LID. If this data is not available, follow the procedures described in the Set Up Machine Control Configuration section on page 50.

   If a CCN Building Supervisor or Service Tool is present, the module configuration should have already been uploaded into memory; then, when the new module is installed, the configuration can be downloaded from the computer.

   Any communication wires from other machines or CCN modules should be disconnected to prevent the new PSIO module from uploading incorrect run hours into memory.
3. Check that all power to the unit is off. Carefully disconnect all wires from the defective module by unplugging the 6 connectors. It is not necessary to remove any of the individual wires from the connectors.
4. Remove defective PSIO by removing its mounting screw with a long-shaft Phillips screwdriver, and removing the module from the control center. Save the screw for later use. The green ground wire is held in place with the module mounting screw.
5. Package the defective module in the carton of the new module for return to Carrier.
6. Mount the new module in the unit control center using a long-shaft Phillips screwdriver and the screw saved in Step 4 above. Make sure that the green grounding wire is reinstalled along with the mounting screw.
7. Connect the LID communication wires (Level II bus) and the power wires only. If CCN wiring has been attached to the Level II bus, disconnect the wires.
8. Carefully check all wiring connections before restoring power.
9. Restore control power and verify that the red and green LEDs on the PSIO are functioning properly.
10. Access the Attach to Network Device table on the LID Service menu. Set the local device address to Bus 0, Address 90. Press the ATTACH softkey to upload the PSIO into the LID.
11. Change the address of the PSIO in the Config table of the Equipment Configuration table back to the previous value. Write the address on the PSIO.
12. Use the configuration sheets to input set point, configuration, and schedule information into the PSIO. Time and Date also must be set through the service menu. A Building Supervisor can be used to download the old configuration into the PSIO.
13. Perform a Control Test and verify all tests. Select Control Test from the service menu

    If the software version has been updated, a CCN download of the configuration will not be allowed. Configure the PSIO by hand, and upload the PSIO into the network by using the Attach to Network Device table.
14. Restore chiller to normal operation, calibrate motor amps.

Solid-State Starters — Troubleshooting guides pertaining to the operation of the solid-state starters may be found in Fig. 49-55 and Tables 13 and 14.

Attempt to solve the problem by using the following preliminary checks before consulting the troubleshooting tables.

When the power is off:

- Inspect for physical damage and signs of arcing, overheating, etc.
- Is the wiring to the starter correct?
- Are all connections in the starter tight?
- Is the current feedback resistor properly adjusted and installed?
- Is a heater coil installed in each leg of the motor?
- Is the control transformer fuse blown?
- Is the motor connected to the starter?

TESTING SILICON CONTROL RECTIFIERS IN BENSHAW, INC. SOLID-STATE STARTERS — If a silicon control rectifier (SCR) is suspected of being defective, use the following procedure as part of a general troubleshooting guide.

IMPORTANT: Before performing the SCR check below, remove power from the starter and disconnect the motor terminals T1, T2, and T3.

1. Connect ohmmeter across terminals L1 and T1. Resistance reading should be greater than 50,000 ohms.
2. If reading is less than 50,000 ohms, remove connecting bus heatsink between SCR3 and SCR6 and check anode to cathode of SCR3 and SCR6 separately to determine which device is defective. See Fig. 49. Replace defective device and retest controller.
3. Repeat Steps 1 and 2 across terminals L2 and T2 for SCRs 2 and 5.
4. Repeat Steps 1 and 2 across terminals L3 and T3 for SCRs 1 and 3.

   If the SCRs tested were not defective but the problem still persists, refer to the following Steps 5 and 6.
5. Disconnect the SCR1 from the white gate and red cathode wires on the control logic card BIPCRS6. With an ohmmeter set on Rx1, check between white and red wires. Resistance should normally be between 8 and 20 ohms average. Excessively high or low resistance may be indicative of a defective device. Replace and retest.
6. Repeat Step 5 for SCR leads 2 through 6. Care should be taken to ensure that the gate and cathode wires are replaced exactly as they were: white wire to gate (G1 through G6); red wire to cathode (K1 through K6).

⚠ CAUTION

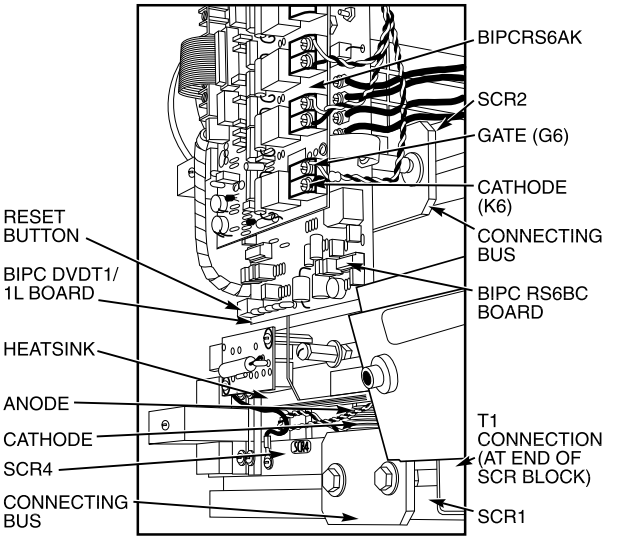
Damage to the starter may result if wires are reversed.

If problem is still not resolved, consult the starter manufacturer for servicing.

TESTING SILICON CONTROL RECTIFIERS (SCRs) IN CUTLER-HAMMER® SOLID-STATE STARTERS — To check for a shorted SCR refer to Steps 1-3 and Fig. 50-53.

NOTE: Do not megger (high voltage insulation test) the starter.

1. Connect ohmmeter across terminals L1 and T1. Check the resistance reading. Resistance reading should be greater than 10,000 ohms.



SCR — Silicon Control Rectifier

Fig. 49 — Typical Benshaw, Inc. Solid-State Starter (Internal View)

2. Connect ohmmeter across terminals L2 and T2. Check the resistance reading. Resistance reading should be greater than 10,000 ohms.
3. Connect ohmmeter across terminals L3 and T3. Check the resistance reading. Resistance reading should be greater than 10,000 ohms.

   If the SCRs tested were not defective, but the problem persists, refer to Steps 4-8.
4. Connect the T1, T2, and T3 terminals on the starter to the motor.
5. Disconnect one of the wires to the shunt trip contact on the starter. This wire is disconnected to prevent the shorted SCR detection from operating the disconnect device while this test is being performed.
6. Close the disconnect breaker. Check the voltage from the starter line terminal to load terminal on each phase. The measured voltage should be approximately 0.58 times the system line-to-line voltage. If the voltage on any power pole is significantly less, one or both SCRs in the power pole may be shorted. See Fig. 51.
7. If a shorted SCR is detected, check for possible shorted connections, system grounds, or any other condition that might be causing the short. Replacement of SCRs or power poles without determining the cause of the failure may result in repeated failure of the SCRs.
8. When the starter is running, measure the voltage from the line side to the load side of each starter power pole. The voltage should be approximately 1 to 1.5 vac.

⚠ DANGER

When measuring voltage from line side to load side, observe proper electrical safety procedures since the power poles have voltage applied. This voltage could be as high as 600 v. Personal injury could result.

If one of the voltages is higher than 2 v, but the voltages of the 3 power poles are approximately equal, the starter is probably still in current limit. If the voltage is higher than 2 v on only 1 or 2 power poles, not all SCRs are firing properly. Make sure the gate lead connections are tight. If all 3 power poles have less than a 2 v drop from line side to load side of each starter power pole when the motor is up to speed, any current unbalance in the motor is caused by the motor or an unbalanced line voltage.

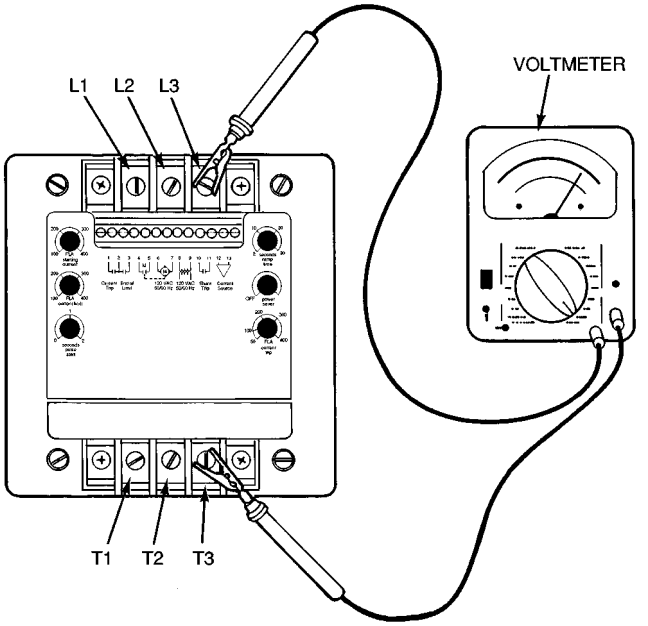
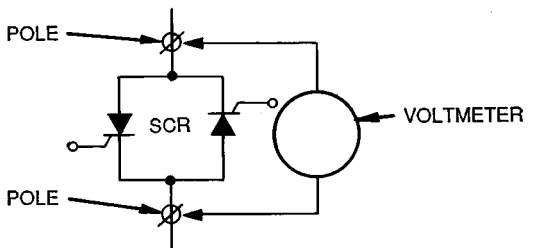
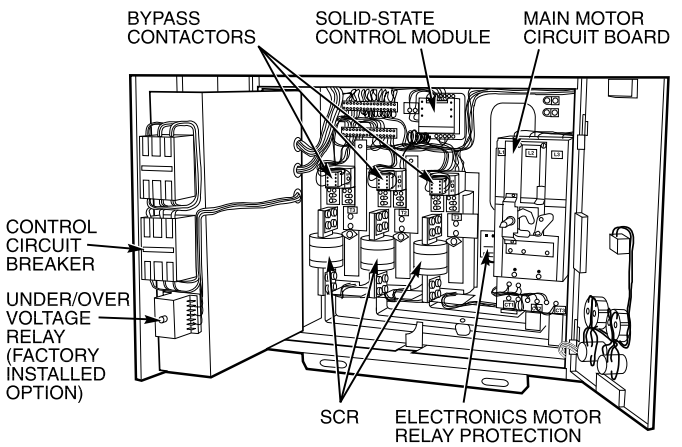


Fig. 50 — Resistance Check



SCR — Silicon Control Rectifier

Fig. 51 — SCR and Power Poles



SCR — Silicon Control Rectifier

Fig. 52 — Typical Cutler-Hammer® Solid-State Starter (Internal View)

ELECTRONIC PROTECTION RELAY (EPR) — On Cutler-Hammer solid state starters, the EPR is designed to provide an alternative to conventional motor protection due to overcurrent. See Fig. 53. It performs the following functions:

Test Button — The TEST button provides testing of the EPR's ability to detect overload, test relay operation, and simulate motor load.

System Ready (SYST RDY) — This light-emitting diode (LED) provides a visual indication that the EPR is functioning.

Trip Time Potentiometer — The Trip Time potentiometer has 50 selectable overload trip classes ranging from 1 to 50 seconds.

Reset Time Potentiometer — The Reset Time potentiometer has 5 to 120 minutes of motor cooling reset.

Full Load Amperes (FLA) — The FLA potentiometer is adjustable from 1 to 1,500 amps, based on overload frame size.

Trip LED — The Trip LED provides a visual indication that the EPR has detected an overload condition and tripped.

Fault (FLT) LED — The FLT LED is an indicator light.

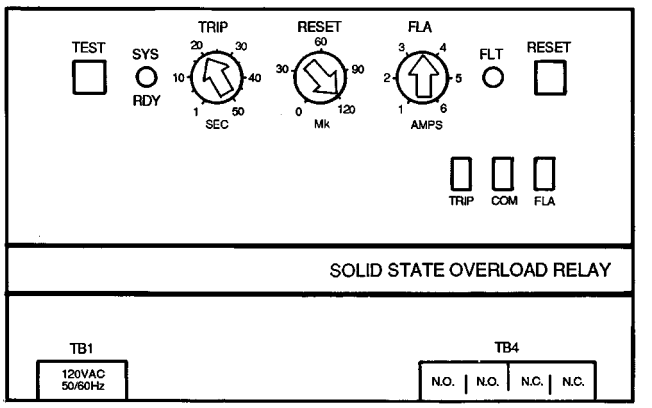
Reset Button — The RESET button allows for the manual reset of the EPR.

Trip, Common (COM), and FLA Test Terminals — The Trip, COM, and FLA test terminals provide for Digital Voltmeter (DVM) calibration.

Terminal 1 (TB1) — Terminal 1 is the 120 vac connection to power the EPR.

Terminal 4 (TB4) — Terminal 4 is the normally closed, electronically isolated EPR contact for overload trip.

NOTE: When the System Ready (SYST RDY) LED is a steady green light, no fault has been found in the solid-state starter operation. When the SYST RDY LED is a steady green light and the fault indicator (FLT) is a flashing red light, the a motor overload trip is approaching. When the FLT LED is a solid red light and the SYST RDY LED is a flashing green light, a motor overload trip has occurred. When the FLT LED is a solid red light and the SYST RDY LED is a solid green light, the overload has tripped because of a phase unbalance.



FLT — Fault LED

Fig. 53 — Cutler-Hammer Terminal Functions

Table 13 — Benshaw, Inc. Solid-State Starter Troubleshooting Guide

PROBLEM	PROBABLE CAUSES	AREA OF CORRECTION
BIPCRS6AK board phase correct not on.	1. L1 and L3 switch phases reversed. 2. Missing phase voltage. 3. Improper line voltage.	1. Switch incoming phases L1 and L3 at top of CD1 or CB1. 2. Check for missing phase voltage. 3. Verify proper line voltage applied against synchronizing transformer voltage.
BIPCRS6AK board relay not on.	Ribbon cable not properly seated.	Check ribbon cable for proper seating. Replace board if necessary.
BIPCRS6AK board power +15 vdc not on.	1. Improper line voltage. 2. Transformer malfunction.	1. Make sure proper line voltage is present at primary synchronizing transformer. 2. Check synchronizing transformer secondary voltage as follows: On the BIPCRS6BC board, measure from TB11-1 to TB11-2 and TB11-3 TB11-1 to TB11-3. Both readings should be within 30 to 36 vac. On the BIPCRS6BC board, measure from TB11-1 to TB11-4 and TB11-2 to TB11-4. Both readings should be within 18 to 24 vac. Replace synchronizing transformer if voltages are not within the specified tolerances.
BIPCDVDT1/1L boards LEDs not on.	1. A short exists between line and load terminals. 2. An SCR is shorted in the phase assembly.	1. Remove power and check resistance with ohmmeter. Locate and remove stray wire strands if required. 2. Remove power. Use ohmmeter to measure the resistance or each SCR phase assembly from anode to cathode. The reading should be 50,000 ohm or greater. If not, replace phase assembly.
BIPCRS6BC board over-temperature LED (L3) on prior to run command.	1. Temperature switch not functioning properly. 2. BIPCRS6BC board not functioning properly.	1. Disconnect power and check for continuity between TB11-10 and TB11-11. If no continuity exists, the over-temperature switch is not functioning properly. Replace defective switch if necessary. 2. Make sure BIPCRS6BC board is functioning properly. Replace board if necessary.
BIPCRS6BC board LEDs on prior to run command.	BIPCRS6BC board not functioning properly.	Board not functioning properly. Replace board, if necessary.
BIPCRS6BC board LEDs not on after run command but before starter reaches full voltage.	1. Phase assembly malfunction. 2. BIPCRS6BC board not functioning properly.	1. Remove power and check SCRs. Ohmmeter reading of each SCR gate to cathode resistance at terminals is 8 to 20 ohm. If not, replace the phase assembly. 2. Replace board, if necessary.
BIPCDVDT1/1L board LEDs remain on after starter reaches full voltage.	Imbalance between phases exists in motor terminal voltages.	Check for loose SCR gate lead or open SCR gate. Replace phase assembly, if necessary.
BIPCRS6BC board run LED (L5) not lit.	BIPCRS6BC board not functioning properly.	Measure 24 vdc at TB11-8 to TB11-4. If voltage is present, replace board. If not present, replace relay 1CR.
BIPCRS6AK board power applied, run command given, starter at full voltage, but aux LED not lit.	BIPCRS6AK board not functioning properly.	Replace board.
BIPCDVDT1/1L boards LEDs lit.	Motor terminal voltage phase imbalance exists.	Check motor terminal voltages for imbalance between phases. If an imbalance exists, check for loose SCR gate or open SCR gate. Replace phase assembly, if necessary.
BIPCRS6BC board LED L4 and L5 not lit.	BIPCRS6BC board not functioning properly.	Replace board.
BIPCRS6BC board LED L3 lit.	1. FU5 and FU6 fuses not functioning properly. 2. Phase assembly not functioning properly. 3. Fan not functioning properly.	1. Check fuses FU5 and FU6. Replace if necessary. 2. Verify that bypass is pulling in by measuring the voltage drop across the contacts. The reading should be 50 mV or less. Replace phase assembly, if necessary. 3. Verify fan operation on each phase for 200 amp units. Replace fan, if necessary.
BIPCRS6BC board L2 lit.	SCR phases not functioning properly.	Measure resistance from anode to cathode for each SCR phase assembly. Replace shorted phase, if necessary.
BIPCRS6BC board L1 lit.	Motor lead grounded.	Megger motor to test for motor lead going to ground.
Start command given.	Motor does not begin rotation.	Turn ‘Starting Torque’ potentiometer RV2 clockwise until motor rotation begins.
Motor does not reach full speed within 25 seconds.	Ramp up setting is not correct.	Turn ‘Ramp’ potentiometer RV1 counterclockwise. Restart motor and verify that motor reaches full speed within 25 seconds.
115 vac missing from LL1 and LL2.	1. CB2 is not on. 2. Fuse no. 4 (FU4) blown.	1. Verify CB2 is on. 2. Check FU4 for continuity. Replace, if necessary.
SMM not responding.	1. CB4 is not on. 2. Potentiometer RV1 needs adjustment.	1. Verify CB4 is on. 2. Adjust potentiometer RV1 for 24 vac at SMM terminals J3-23 and J3-24.

LEGEND

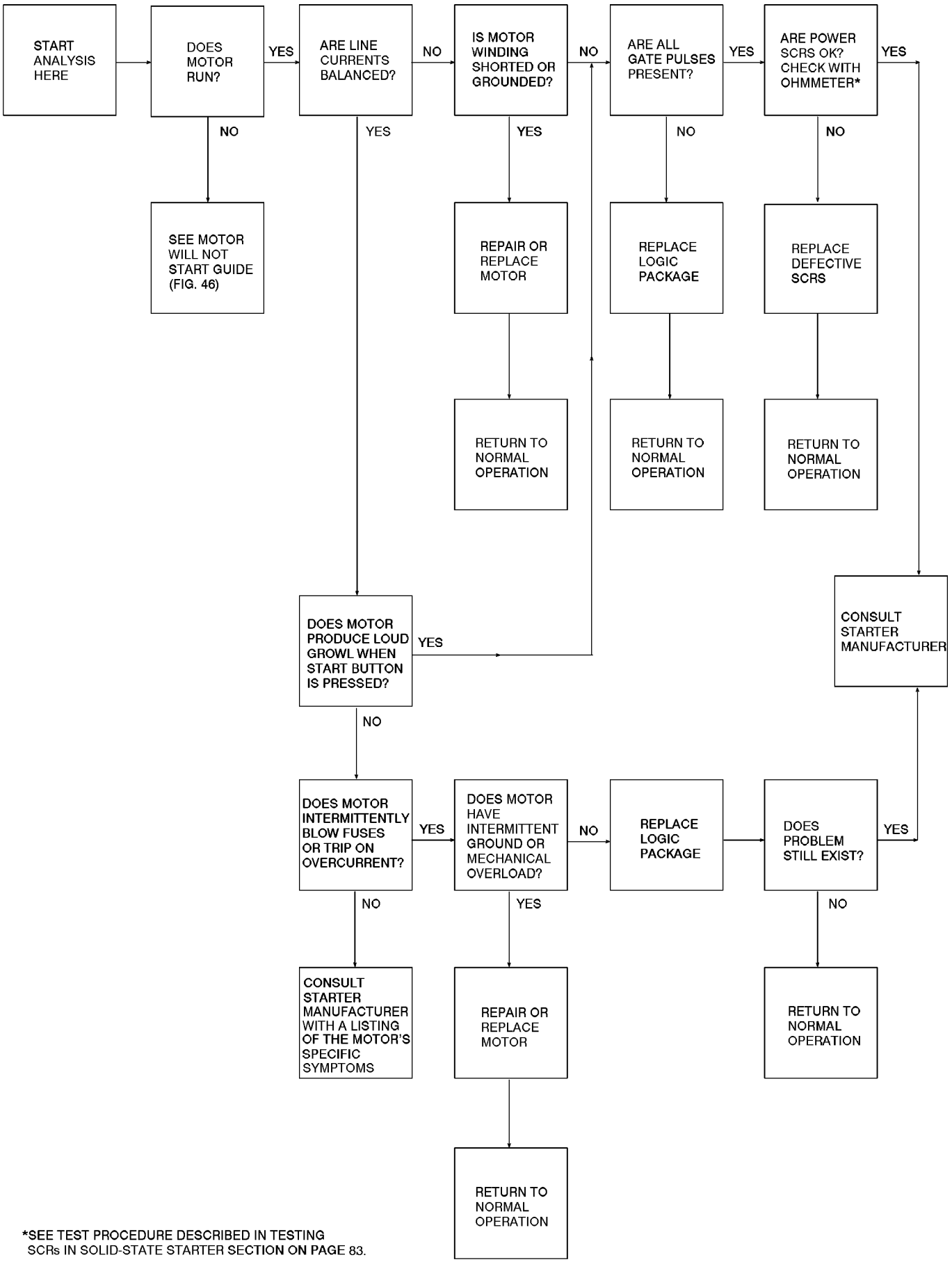
LED — Light-Emitting Diode
SCR — Silicon Control Rectifier
SMM — Starter Management Module

Table 14 — Cutler-Hammer® Solid-State Starter Troubleshooting Guide

PROBLEM	PROBABLE CAUSE	AREA OF CORRECTION
(CB) trips (electrically operated disconnecting means opens) as it is closed.	Motor is not connected.	Connect motor to starter.
	Incorrect phase sequence to the starter, 3-phase power not connected, or terminal loose.	Switch two incoming power leads. The 50 and 51 corresponding motor leads must also be switched to maintain the same motor rotation.
	Shorted SCR.	Perform shorted SCR check.
	Shunt trip contact between terminals closes due to shorted SCR.	Perform shorted SCR check.
	Shunt trip latching relay not reset (if used).	Reset STR relay by pushing RESET button on relay.
CB trips while motor is running.	Microprocessor detected non-standard operation.	Check wiring to logic module or replace logic module.
CB trips when STOP is pressed.	Voltage drop across SCR (looks like shorted SCR).	Check SCR.
Starter does not pick up and maintain.	Line voltage is not applied.	Check incoming lines for proper voltage.
	Overload is not reset.	Reset overload.
	120 v control voltage is not present.	Check control transformer fuse. Check control circuits.
	Heatsink overtemperature switches are open.	Check for continuity through overtemperature switches. Check that all fans are rotating freely. Check for excessive motor current draw.
Starter maintains but motor does not accelerate or does not attain full speed (stalls).	Current limit is too low.	Increase current limit setting clockwise. Set ramp time to minimum (counterclockwise).
Insufficient Torque.	Improper current feedback.	Check current feedback resistor for proper calibration.
	High breakaway torque required.	Load is not suitable for reduced voltage starting.
Motor accelerates too slowly.	Current limit is too low.	Increase current limit setting clockwise.
	Ramp time is too long.	Decrease ramp time setting counterclockwise.
	Broken current feedback resistor.	Check by recalibrating CFR.
Motor accelerates too quickly.	Current limit is too high.	Decrease current limit setting counterclockwise.
	Improper current feedback.	Check current calibrator for proper resistance value.
	Pulse start setting is too long.	Decrease pulse start time counterclockwise.
	Broken current feedback transformer wire.	Check for a broken current feedback transformer wire.
Current limit adjustment has no effect during acceleration.	Improper current feedback.	Check current calibrator for proper resistance value.
Starter or motor is noisy or vibrates when starting.	Single phasing due to open phase.	Check wiring and overload heater coils.
	Single phasing or unbalanced current due to non-firing SCR.	Check gate lead wiring to SCRs.
	Defective motor.	Check motor for shorts, opens, and grounds.
Mechanical shock to machine.	Current increases too quickly.	Decrease starting current counterclockwise. If necessary, increase ramp time clockwise.
End of limit contact does not close.	Starter is in current limit.	Perform SCR full voltage test.
Current trip contact does not close when current goes above the trip setting.	Improper current feedback.	Check current calibrator for proper resistance value.
Current trip contact closes when current is below trip setting.	Improper current feedback.	Check current calibrator for proper resistance value.
Motor current, voltage, and speed oscillate.	Power saver is misadjusted.	Turn power saver adjustment CCW until oscillations cease.
Overload relay trips when starting.	Incorrect heater coils (melting allow).	Check heater coil rating.
	Loose heater coil.	Tighten heater coil.
	Long starting time (high inertia applications may require slow trip overload and oversize starter).	Motor and starter thermal capabilities must be evaluated before extending overload trip times.
	Mechanical problems.	Check machinery for binding or excessive loading.
	Single phasing.	See ‘‘Starter or motor is noisy or vibrates when starting’’ symptom in troubleshooting table.
	Excessive starting time (current limit may be set too low).	Increase current limit setting clockwise.
Overload relay trips when running.	Incorrect heater coils (melting alloy).	Check heater coil rating.
	Mechanical problems.	Check machinery for binding or excessive loading.
	Single phasing.	See ‘‘Starter or motor is noisy or vibrates when starting’’ problem in troubleshooting table.
Heatsink overtemperature switch opens.	Excessive current.	Check motor current draw.
	Defective heatsink, fan.	Check that all fans are rotating freely.
Erratic operation.	Loose connections.	Check all connections.

LEGEND

CCW — Counter Clockwise
CFR — Current Feedback Resistor
STR — Shunt Trip Relay



SCR — Silicon Control Rectifier

Fig. 54 — Typical Solid-State Starter, General Operation Troubleshooting Guide

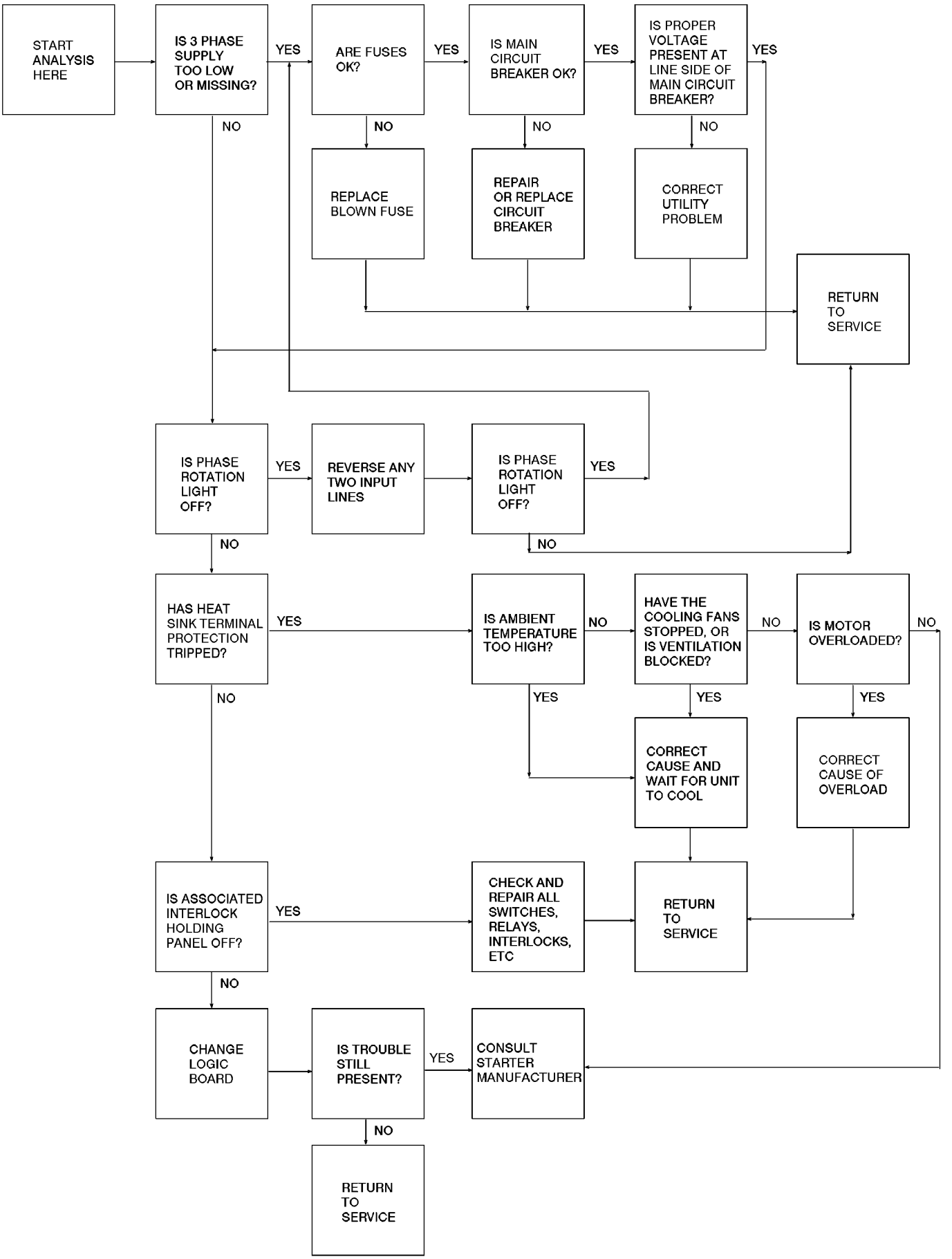


Fig. 55 — Typical Solid-State Starter, Starter Fault (Motor Will Not Start) Troubleshooting Guide

Physical Data — For operator convenience during troubleshooting, additional details regarding compressor torque specifications, physical data, electrical data, and wiring schematics may be found in Tables 15-21 and Fig. 56-62.

Table 15 — 23XL Heat Exchanger Weights

SIZE	ENGLISH								SI							
	Dry Wt (lb)*		Machine Charge						Dry Wt (kg)*		Machine Charge					
			Refrigerant (lb)				Water (gal)				Refrigerant (kg)				Water (L)	
	Cooler Only†	Cond Only	Economizer		No Economizer		Cooler	Cond	Cooler Only†	Cond Only	Economizer		No Economizer		Cooler	Cond
			HCFC-22	HFC-134a	HCFC-22	HFC-134a					HCFC-22	HFC-134a	HCFC-22	HFC-134a		
10	2480	2890	650	**	600	**	34	39.2	1125	1310	295	**	272	**	130	150
11	2650	3020	650	**	600	**	40	44.4	1202	1370	295	**	272	**	152	168
20	2845	3250	750	**	700	**	45	49.2	1291	1474	340	**	318	**	170	186
21	3000	3445	750	**	700	**	49	56.4	1361	1563	340	**	318	**	186	214
40	5030	4690	1000	850	900	800	49.2	51.6	2282	2127	454	386	408	363	186	195
41	5180	4835	1100	900	1000	850	54	57	2350	2193	499	408	454	386	204	216
42	5345	5005	1200	950	1100	900	60	63	2424	2270	544	431	499	408	227	239
43	5525	5185	1300	1000	1200	950	66	70	2506	2352	590	454	544	431	250	264

NIH — Nozzle-In-Head

*Weight based on: .035 in. wall copper Turbo-B2 tubes in cooler, Turbo chill in condenser.
2-pass, 150 psi NIH waterbox arrangements (sizes 10, 11, 20, 21)
3-pass, 300 psi NIH waterbox arrangements (sizes 40, 41, 42, 43)
†Weight of optional economizer is not included and must be added to cooler weight.
**Not available.

NOTE: Standard shipment is with refrigerant charged, so be sure to add refrigerant charge to dry weight.

Table 16 — 23XL Compressor Weights

23XL UNIT	COMPRESSOR SIZE (Tons)	ASSEMBLY	
		lb	kg
Frame 1	C2	2270	1029
	C4	2300	1043
Frame 2	C6	2400	1088
Frame 4	D4	3300	1497
	D6	3400	1542

Table 17 — 23XL Component Weights

COMPONENT	FRAME 1 AND 2		FRAME 4	
	lb	kg	lb	kg
Oil Separator	1180	535	2880*	1306*
Economizer†	296	134	560	254
Muffler	170	77	*	*
Discharge Piping:				
Pipe	44	20	—	—
Isolation Valve†	30	14	30	14
Adaptor Flange	76	34	76	34
Power Panel	20	9	20	9
Starter†	500	227	500	227
Control Center	31	14	31	14

*The Frame 4 muffler is included in the oil separator weight.
†Optional.

Table 18 — Optional Storage Tank and/or Pumpout System Physical Data

UNIT SIZE	TANK OUTSIDE DIAMETER		DRY WEIGHT		MAXIMUM REFRIGERANT CAPACITY							
					ASHRAE/ANSI 15				ARI 495			
					HCFC-22		HFC-134a		HCFC-22		HFC-134a	
	in.	mm	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
28	24.00	610	2200	998	1840	835	1865	845	1645	747	1665	755
52	27.25	692	3270	1606	3525	1599	3570	1619	3155	1431	3195	1449

LEGEND

ANSI — American National Standards Institute
ARI — Air Conditioning and Refrigeration Institute
ASHRAE — American Society of Heating, Refrigeration, and Air Conditioning Engineers

NOTES:
1. ANSI/ASHRAE 15 — Safety Code for Mechanical Refrigeration
2. Dry weights include the pumpout condensing unit weight of 210 lbs (95 kg).

Table 19 — Optional Storage Tank and/or Pumpout System Electrical Data

MOTOR CODE	CONDENSER UNIT	VOLTS-PH-HZ	MAX RLA	LRA
1	19EA47-748	575-3-60	3.8	23.0
4	19EA42-748	200/208-3-60	10.9	63.5
5	19EA44-748	230-3-60	9.5	57.5
6	19EA46-748	400/460-3-50/60	4.7	28.8

LRA — Locked Rotor Amps
RLA — Rated Load Amps

Table 20A — 23XL Waterbox Cover Weights (Frame 1 and 2 Machines)*

HEAT EXCHANGER	WATERBOX DESCRIPTION	PSI (kPa)	FRAME 1		FRAME 2	
			lbs	kg	lbs	kg
Cooler or Condenser	NIH, 1 Pass	150 (1034)	118	54	128	58
	NIH, 2 Pass (Plain)		100	46	148	67
	NIH, 2 Pass (With Pipe Nozzles)		185	84	200	91
	NIH, 3 Pass	150 (1034)	166	76	180	82

LEGEND

NIH — Nozzle-In-Head

*These weights are given for reference only. They have been included in heat exchanger weights shown in Table 15.

NOTE: Add 30 lb (14 Kg) for bolts.

Table 20B — 23XL Waterbox Cover Weight (Frame 4 Machines)*

HEAT EXCHANGER	WATERBOX DESCRIPTION	ENGLISH (lb)				SI (kg)			
		Frame 4, Std Nozzles		Frame 4, Flanged		Frame 4, Std Nozzles		Frame 4, Flanged	
		150 psig	300 psig	150 psig	300 psig	1034 kPa	2068 kPa	1034 kPa	2068 kPa
COOLER	NIH, 1 Pass Cover	284	414	324	491	129	188	147	223
	NIH, 2 Pass Cover	285	411	341	523	129	187	155	237
	NIH, 3 Pass Cover	292	433	309	469	133	197	140	213
	NIH, Plain End Cover	243	292	243	292	110	133	110	133
	MWB Cover	CS	621	CS	621	CS	282	CS	282
	Plain End Cover	CS	482	CS	482	CS	219	CS	219
CONDENSER	NIH, 1 Pass Cover	306	446	346	523	139	202	157	237
	NIH, 2 Pass Cover	288	435	344	547	131	197	156	248
	NIH, 3 Pass Cover	319	466	336	502	145	212	153	228
	NIH, Plain End Cover	226	271	226	271	103	123	103	123
	MWB Cover	CS	474	CS	474	CS	215	CS	215
	Plain End Cover	CS	359	CS	359	CS	163	CS	163

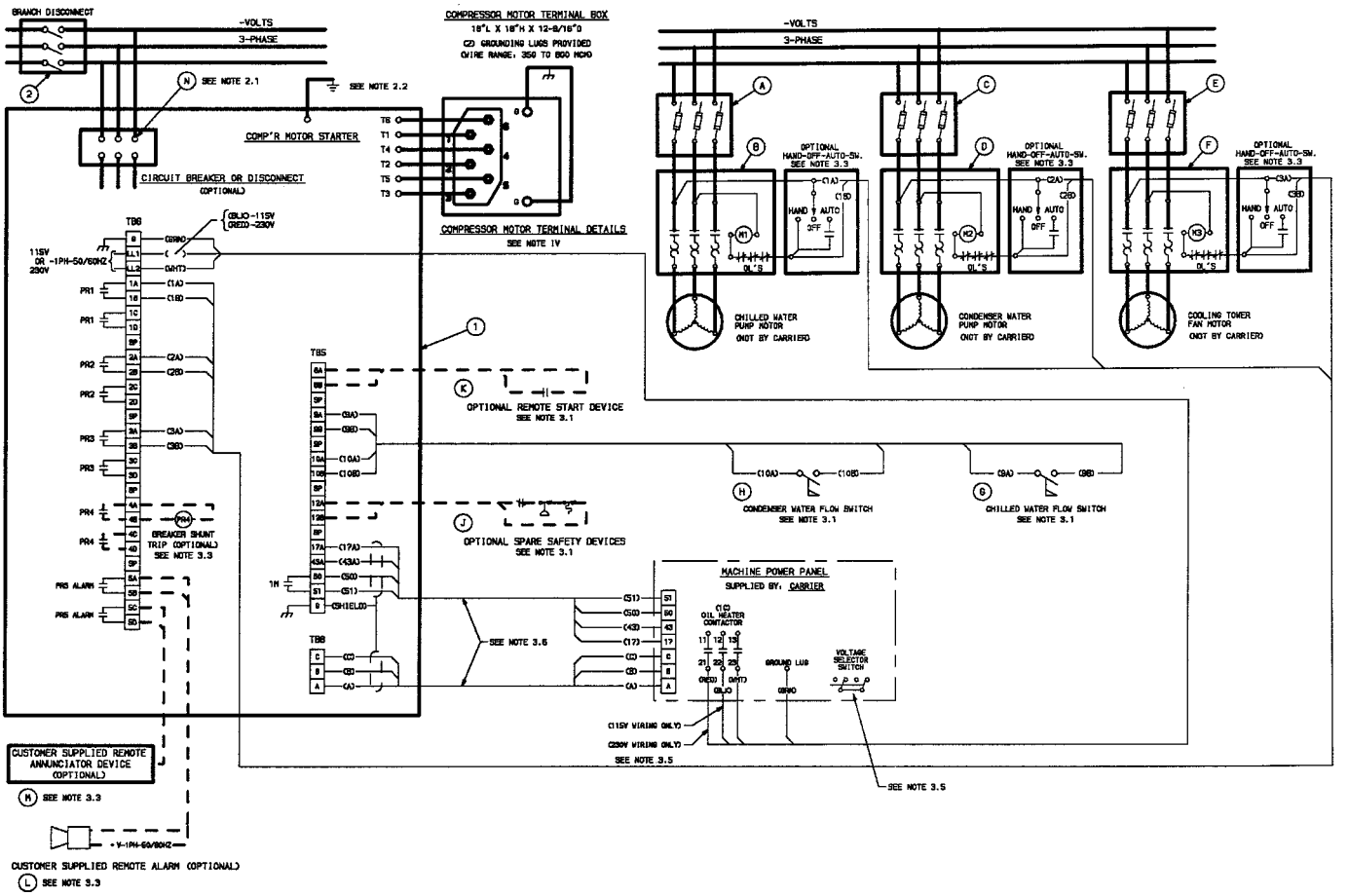
LEGEND

CS — Contact Syracuse
MWB — Marine Waterbox
NIH — Nozzle-In-Head

*These weights are given for reference only. The 150 psig (1034 kPa) standard waterbox cover weights have been included in the heat exchanger weights shown in Table 15.

Table 21 — 23XL Compressor Torque Specification Chart for Metric and American Fasteners

ITEM	CAP SCREW SIZE AND TYPE	GRADE	ASSEMBLY LOCATION	TORQUE		
				Nm	Lb-Ft	Lb-in.
CAP SCREW	M5 X 0.8 X 12 S.H.	10.9	1. FUSITE-MOTOR CASING 2. SLIDE SEAL RETAINER-CYLINDER STOP	4.1-5.4	3-4	36-48
	M6 X 1 X 16 S.H.		1. CONTROL VALVES-SLIDE CASING 2. SLIDE SEAL ADAPTOR-SEPARATOR PLATE (FRAME 1 AND 2 ONLY) 3. SLIDE SEAL ADAPTOR-SLIDE CASING PLUG (FRAME 4 ONLY)	6.8-9.6	5-7	60-84
	M10 X 1.5 X 35 H.H.		1. BRG RETAINER-MALE ROTOR 2. BRG RETAINER-FEMALE ROTOR	41-47	30-35	N/A
	M10 X 1.5 X 40 S.H.		1. SLIDE VALVE COVER-SLIDE CASING 2. SLIDE CASING-SEPARATOR PLATE (FRAME 1 AND 2 ONLY)	61-68	45-50	N/A
	M10 X 1.5 X 50 H.H.		1. MOTOR ROTOR-MALE ROTOR	20-27	15-20	N/A
	M12 X 1.75 X 40 S.H.		1. SERVICE VALVE PAD-MOTOR COVER	103-115	75-85	N/A
	M12 X 1.75 X 50 S.H.		FRAME 1 AND 2 ONLY 1. MOTOR COVER-MOTOR CASING 2. SEPARATOR PLATE-OUTLET CASING 3. DISCHARGE COVER-OUTLET CASING			
	M12 X 1.75 X 60 S.H.		1. MOTOR END PLATE-MOTOR COVER-MOTOR CASING (FRAME 1 AND 2 ONLY) 2. MOTOR COVER-MOTOR CASING (FRAME 4 ONLY) 3. SLIDE CASING-OUTLET CASING (FRAME 4 ONLY)			
	M12 X 1.75 X 70 S.H.		FRAME 4 ONLY 1. MOTOR END PLATE-MOTOR COVER-MOTOR CASING			
	M12 X 1.75 X 80 S.H.		FRAME 1 AND 2 ONLY 1. SLIDE CASING-SEPARATOR PLATE-OUTLET CASING			
	M12 X 1.75 X 90 S.H.		FRAME 4 ONLY 1. SLIDE CASING (BOTTOM)-OUTLET CASING			
	FRAME 1 AND 2 M16 X 2 X 55 S.H. FRAME 4 M16 X 2 X 70 S.H.		1. ROTOR CASING-INLET CASING AND OUTLET CASING 2. MOTOR CASING-INLET CASING 3. OPEN DRIVE END COVER-INLET CASING 4. DISCHARGE COVER-OUTLET CASING (FRAME 4 ONLY)	252-280	185-205	N/A
	M20 X 2.5 X 70 S.H.		1. INLET FLANGES-INLET CASING (FRAME 1 AND 2 ONLY)	485-513	355-375	N/A
	M22 X 2.5 X 80 S.H.		FRAME 4 ONLY 1. INLET FLANGES-INLET CASING	697-724	510-530	N/A
SET SCREW	M10 X 1.5 X 16 S.S.	10.9	FRAME 4 ONLY 1. OPEN DRIVE SEAL ADAPTER	41-47	30-35	N/A
	M10 X 1.5 X 30 S.S.		1. STATOR KEY LOCK	13-20	10-15	120-180
PIPE PLUG	1/8 NPTF	N/A	1. INLET CASING	20-27	15-20	180-240
	1/4 NPTF		FRAME 4 ONLY 1. SLIDE CASING	27-34	20-25	240-300
HEX PLUG	7/16-20	N/A	1. INLET CASING 2. SLIDE CASING	13-16	10-12	130-140
	9/16-18		1. MOTOR CASING 2. OUTLET CASING 3. ROTOR CASING 4. SLIDE CASING	23-26	17-19	210-230
	3/4-16		1. OUTLET CASING 2. SLIDE CASING (FRAME 1 AND 2 ONLY)	60-65	44-48	530-570
	1 1/16-12		1. INLET CASING 2. ROTOR CASING 3. OUTLET CASING	112-125	83-92	1000-1100
	1 3/16-12		FRAME 4 ONLY 1. OUTLET CASING	125-140	92-103	1100-1240
TERMINAL PIN	5/8-11	N/A	1. TERMINAL NUTS 2. MOTOR LEAD	23-26	17-19	N/A
	1 3/16-12		1. TERMINAL PIN BODY 2. MOTOR CASING	27-34	20-25	N/A
LOCKNUT	M20 X 1	N/A	1. SLIDE VALVE ASSEMBLY	68-75	50-55	N/A
	M35 X 1.5		1. SLIDE VALVE ASSEMBLY	95-102	70-75	N/A
RELIEF VALVE	1-5/8-12 UN-2A	N/A	1. ROTOR CASING	345-379	254-279	N/A
PLUG, ORIFICE	M8 X 1.25	N/A	1. INLET CASING 2. OPEN DRIVE END COVER (FRAME 1 AND 2 ONLY)	19-24	14-18	168-216
WAFER HEAD SCREW	M6 X 1	N/A	FRAME 4 ONLY 1. SLIDE VALVE ASSEMBLY	13-15	10-11	120-130



IMPORTANT: Refer to certified drawings for additional information. Certified drawings are available upon request.

LEGEND

- Required Power Wiring
- Required Control Wiring
- Options Wiring

NOTES:

I. GENERAL

1.0 Starters shall be designed and manufactured in accordance with Carrier Engineering Requirement Z-375.

1.1 All field-supplied conductors, devices, field-installation wiring, and termination of conductors and devices, must be in compliance with all applicable codes and job specifications.

1.2 The routing of field-installed conduit and conductors and the location of field-installed devices, must not interfere with equipment access or the reading, adjusting, or servicing of any component.

1.3 Equipment, installation, and all starting and control devices must comply with details in equipment submittal drawings and literature.

1.4 Contacts and switches are shown in the position they would assume with the circuit deenergized and the chiller shut down.

1.5 WARNING — Do not use aluminum conductors.

1.6 Installer is responsible for any damage caused by improper wiring between starter and machine.

II. POWER WIRING TO STARTER

2.0 Power conductor rating must meet minimum unit nameplate voltage and compressor motor RLA (rated load amps).
When (3) conductors are used:
Minimum ampacity per conductor = 1.25 x compressor RLA
When (6) conductors are used:
Minimum ampacity per conductor = 0.721 x compressor RLA

2.1 Lug adapters may be required if installation conditions dictate that conductors be sized beyond the minimum ampacity required. Contact starter supplier for lug information.

2.2 Compressor motor and controls must be grounded by using equipment grounding lugs provided inside starter enclosure.

III. CONTROL WIRING

3.0 Field supplied control conductors to be at least 18 AWG (American Wire Gage) or larger.

3.1 Chilled water and condenser water flow switch contacts, optional remote start device contacts and optional spare safety device contacts, must have 24 vdc rating. Max current is 60 ma, nominal current is 10 ma. Switches with gold plated bifurcated contacts are recommended.

3.2 Remove jumper wire between 12A and 12B before connecting auxiliary safeties between these terminals.

3.3 Pilot relays can control cooler and condenser pump and tower fan motor contactor coil loads rated 10 amps at 115 vac up to 3 amps at 600 vac. Control wiring required for Carrier to start pumps and tower fan motors must be provided to assure machine protection. If primary pump and tower fan motor control is by other means, also provide a parallel means for control by Carrier. Do not use starter control transformer as the power source for pilot relay loads.

3.4 Do not route control wiring carrying 30 v or less within a conduit which has wires carrying 50 v or higher or along side wires carrying 50 v or higher.

3.5 Voltage selector switch in machine power panel is factory set for 115 v control power source. When 230 v control power source is used, set switch to 230 v position.

3.6 Control wiring cables between starter and power panel must be shielded with minimum rating of 600 v, 80 C. Ground shield at starter.

IV. POWER WIRING BETWEEN STARTER AND COMPRESSOR MOTOR

4.0 Low voltage (600 v or less) compressor motors have (6) ½ in. terminal studs (lead connectors not supplied by Carrier). Either 3 or 6 leads must be run between compressor motor and starter, depending on type of motor starter employed. If only 3 leads are required, jumper motor terminals as follows: 1 to 6, 2 to 4, 3 to 5. Center to center distance between terminals is 2.73 inches. Compressor motor starter must have nameplate stamped as to conforming with Carrier requirement "Z-375."

4.1 When more than one conduit is used to run conductors from starter to compressor motor terminal box, one conductor from each phase must be in each conduit, to prevent excessive heating. (e.g., conductors to motor terminals 1, 2 and 3 in one conduit, and these to 4, 5 and 6 in another.)

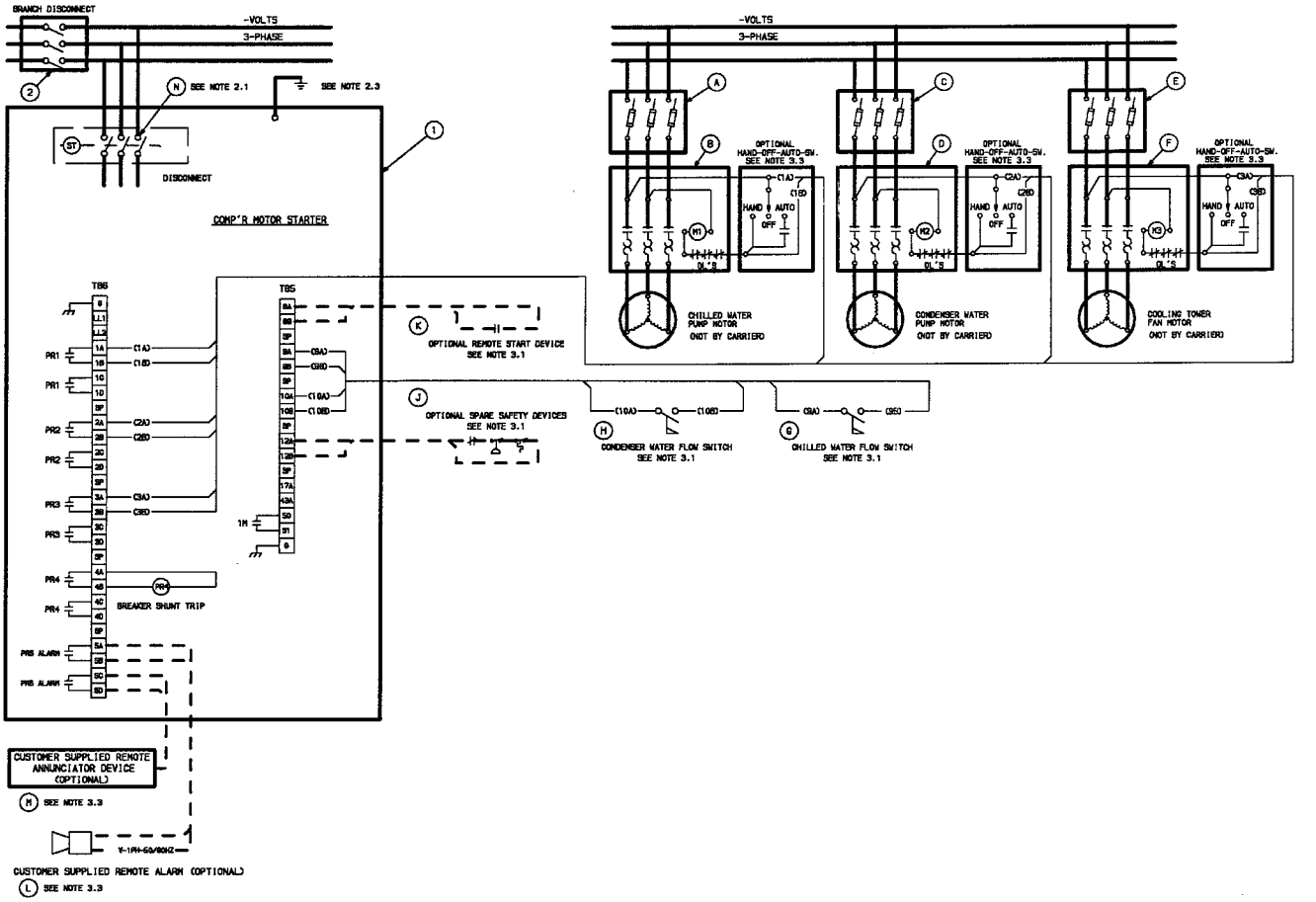
4.2 Compressor motor power connections can be made through top, bottom, or right side of compressor motor terminal box by rotating the terminal box and using holes cut by contractor to suit conduit. Flexible conduit should be used for the last few feet to the terminal box for unit vibration isolation. Use of stress cones or 12 conductors larger than 500 MCM may require an oversize (special) motor terminal box (not supplied by Carrier). Lead connections between 3-phase motors and their starters must not be insulated until Carrier personnel have checked compressor rotation.

4.3 Compressor motor frame to be grounded in accordance with the National Electrical Code (NFPA-70) and applicable codes. Means for grounding compressor motor is (2) Thomas and Betts pressure connectors for 350 to 800 MCM wire, supplied and located in the back upper and lower right side corners of the compressor motor terminal box.

4.4 Do not allow motor terminals to support weight of wire cables. Use cable supports and strain reliefs as required.

4.5 Use back up wrench when tightening lead connectors to motor terminal studs. Torque to 10-15 lb-ft max.

Fig. 56 — 23XL Typical Field Wiring with Free-Standing Starter (Frame 1 and 2 Machines Shown)



IMPORTANT: Refer to certified drawings for additional information. Certified drawings are available upon request.

LEGEND

- Required Power Wiring
- Required Control Wiring
- Options Wiring

NOTES:

I. GENERAL

1.0 Starters shall be designed and manufactured in accordance with Carrier Engineering Requirement Z-375.

1.1 All field-supplied conductors, devices, field-installation wiring, and termination of conductors and devices, must be in compliance with all applicable codes and job specifications.

1.2 The routing of field-installed conduit and conductors and the location of field-installed, devices must not interfere with equipment access or the reading, adjusting, or servicing of any component.

1.3 Equipment installation and all starting and control devices must comply with details in equipment submittal drawings and literature.

1.4 Contacts and switches are shown in the position they would assume with the circuit deenergized and the chiller shut down.

1.5 WARNING — Do not use aluminum conductors.

II. POWER WIRING TO STARTER

2.0 Power conductor rating must meet minimum unit nameplate voltage and compressor motor RLA (rated load amps).

When (3) conductors are used:
Minimum ampacity per conductor = 1.25 x compressor RLA

When (6) conductors are used:
Minimum ampacity per conductor = 0.721 x compressor RLA

2.1 Lug adapters may be required if installation conditions dictate that conductors be sized beyond the minimum ampacity required. Solid-state starters are provided with:

A. Two (2) 0-250 MCM lugs provided per phase for power conductor terminations when compressor motor RLA is 400 amps or less.

B. Three (3), 250-500 MCM lugs provided per phase for power conductor terminations when compressor motor RLA is more than 400 amps.

Wye-Delta starters are provided with:

A. Two (2) 250-500 MCM lugs provided per phase for power conductor terminators when compressor motor RLA is 420 amps or less.

B. Two (2) #1-500 MCM lugs provided per phase for power conductor terminations when compressor motor RLA is more than 420 amps.

2.2 Power conductors to starter must enter through top of enclosure. Flexible conduit should be used for the last few feet to the enclosure to provide unit vibration isolation.

2.3 Compressor motor and controls must be grounded by using equipment grounding lugs provided inside starter enclosure.

2.4 Wye-Delta starters require the assembly and the installation of a "Top Hat" (located inside enclosure) to provide the required wire bending space for incoming power leads.

III. CONTROL WIRING

3.0 Field supplied control conductors to be at least 18 AWG (American Wire Gage) or larger.

3.1 Chilled water and condenser water flow switch contacts, optional remote start device contacts and optional spare safety device contacts, must have 24 vdc rating. Max current is 60 ma, nominal current is 10 ma. Switches with gold plated bifurcated contacts are recommended.

3.2 Remove jumper wire between 12A and 12B before connecting auxiliary safeties between these terminals.

3.3 Pilot relays can control cooler and condenser pump and tower fan motor contactor coil loads rated 10 amps at 115 vac up to 3 amps at 600 vac. Control wiring required for Carrier to start pumps and tower fan motors must be provided to assure machine protection. If primary pump and tower fan motor control is by other means, also provide a parallel means for control by Carrier. Do not use starter control transformer as the power source for pilot relay loads.

3.4 Do not route control wiring carrying 30 v or less within a conduit which has wires carrying 50 v or higher or along side wires carrying 50 v or higher.

Fig. 57 — 23XL Typical Field Wiring with Optional Unit-Mounted Starter (Frame 1 and 2 Machines Shown)

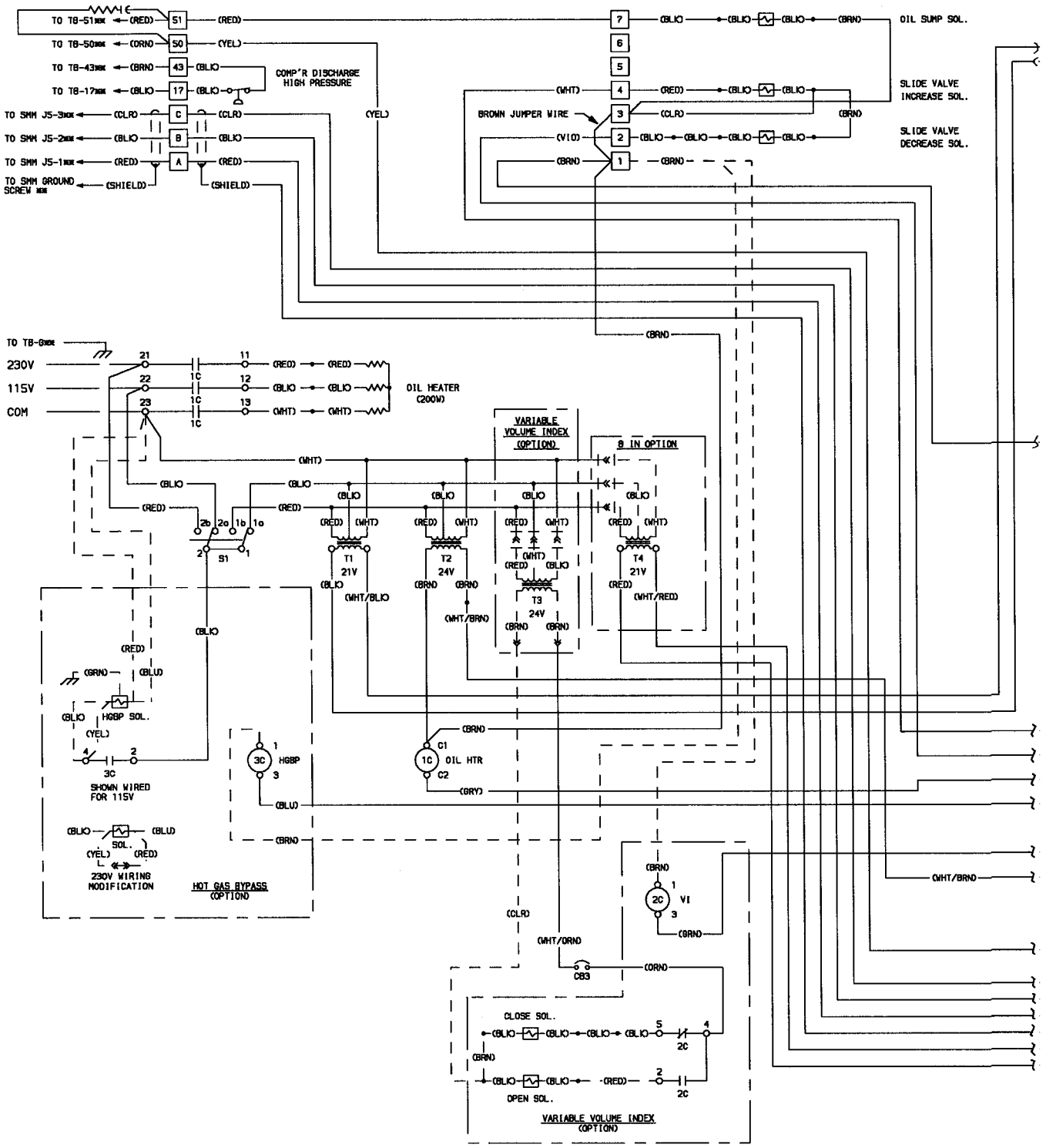


Fig. 58 — Typical Electronic PIC Controls Wiring Schematic (Frame 1 and 2 Machines)

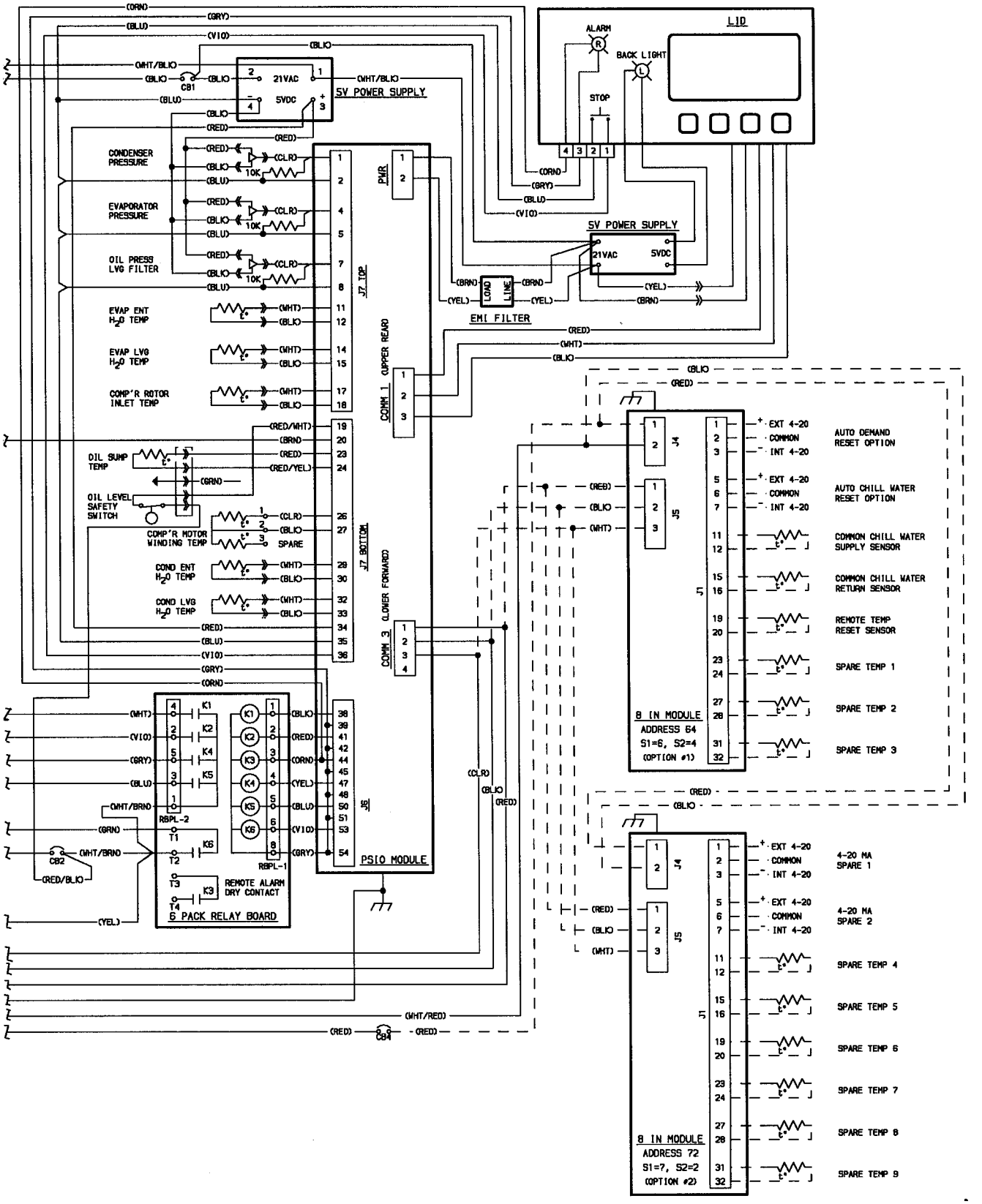


Fig. 58 — Typical Electronic PIC Controls Wiring Schematic (Frame 1 and 2 Machines) (cont)

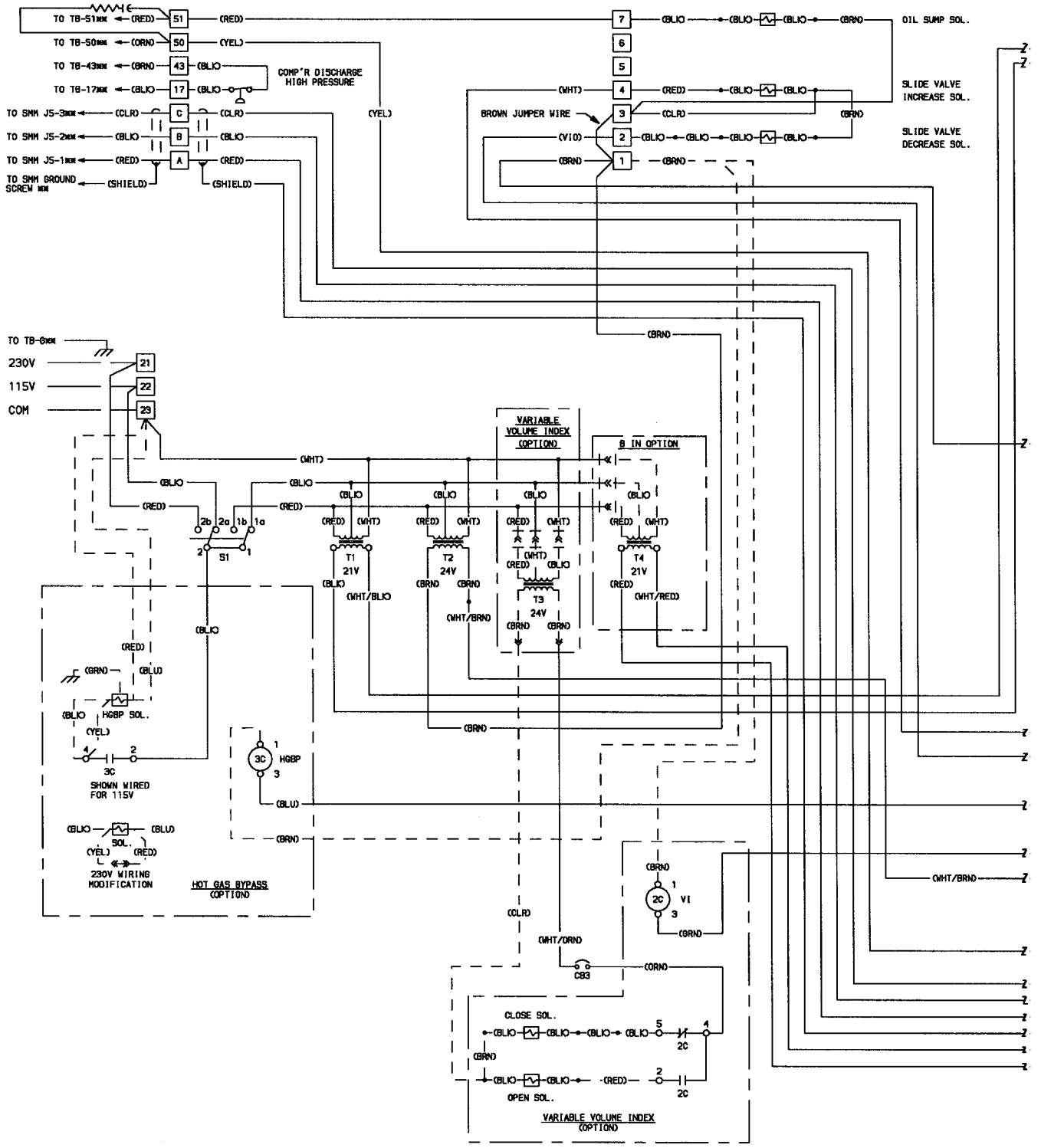


Fig. 59 — Typical Electronic PIC Controls Wiring Schematic (Frame 4 Machines)

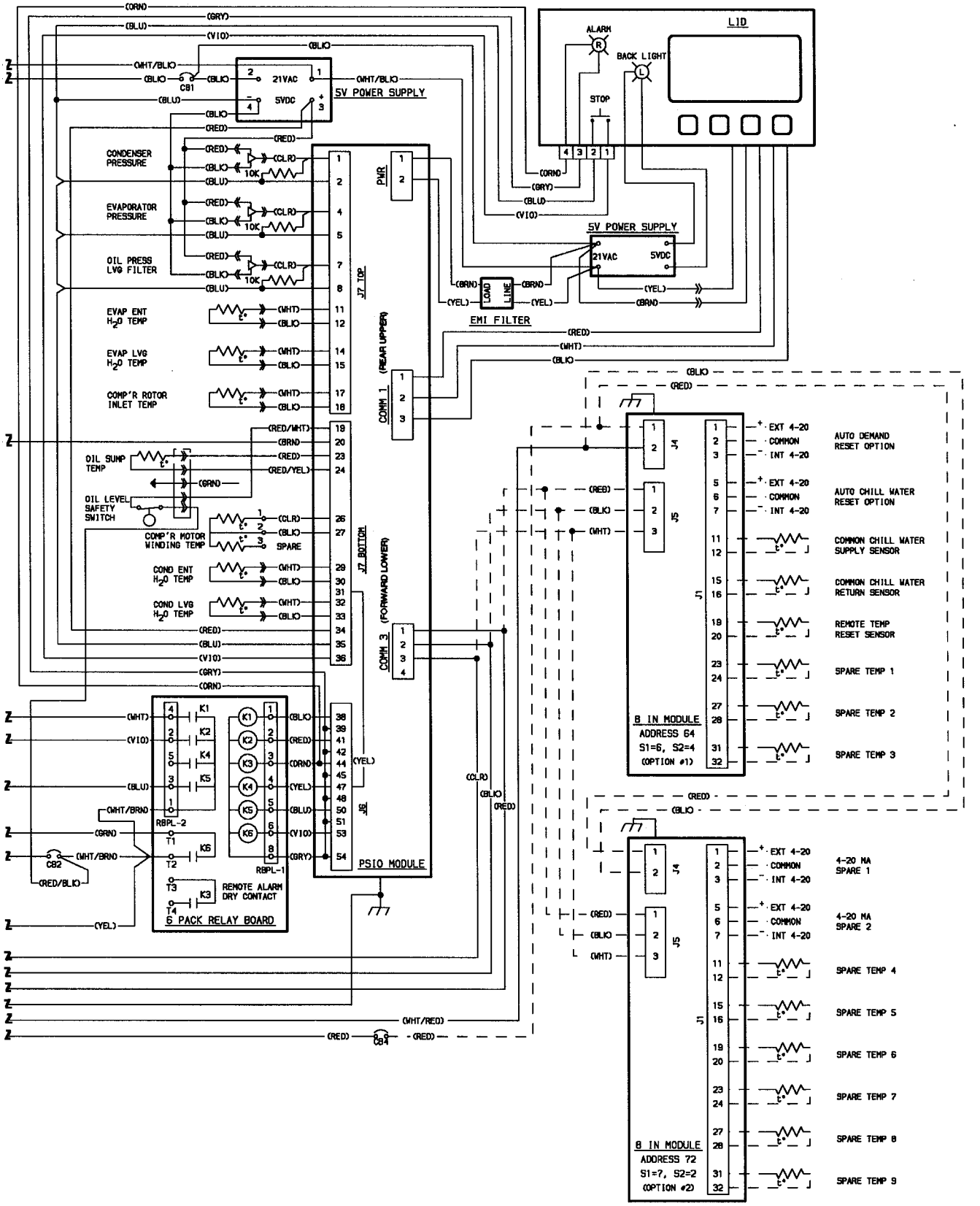


Fig. 59 — Typical Electronic PIC Controls Wiring Schematic (Frame 4 Machines) (cont)

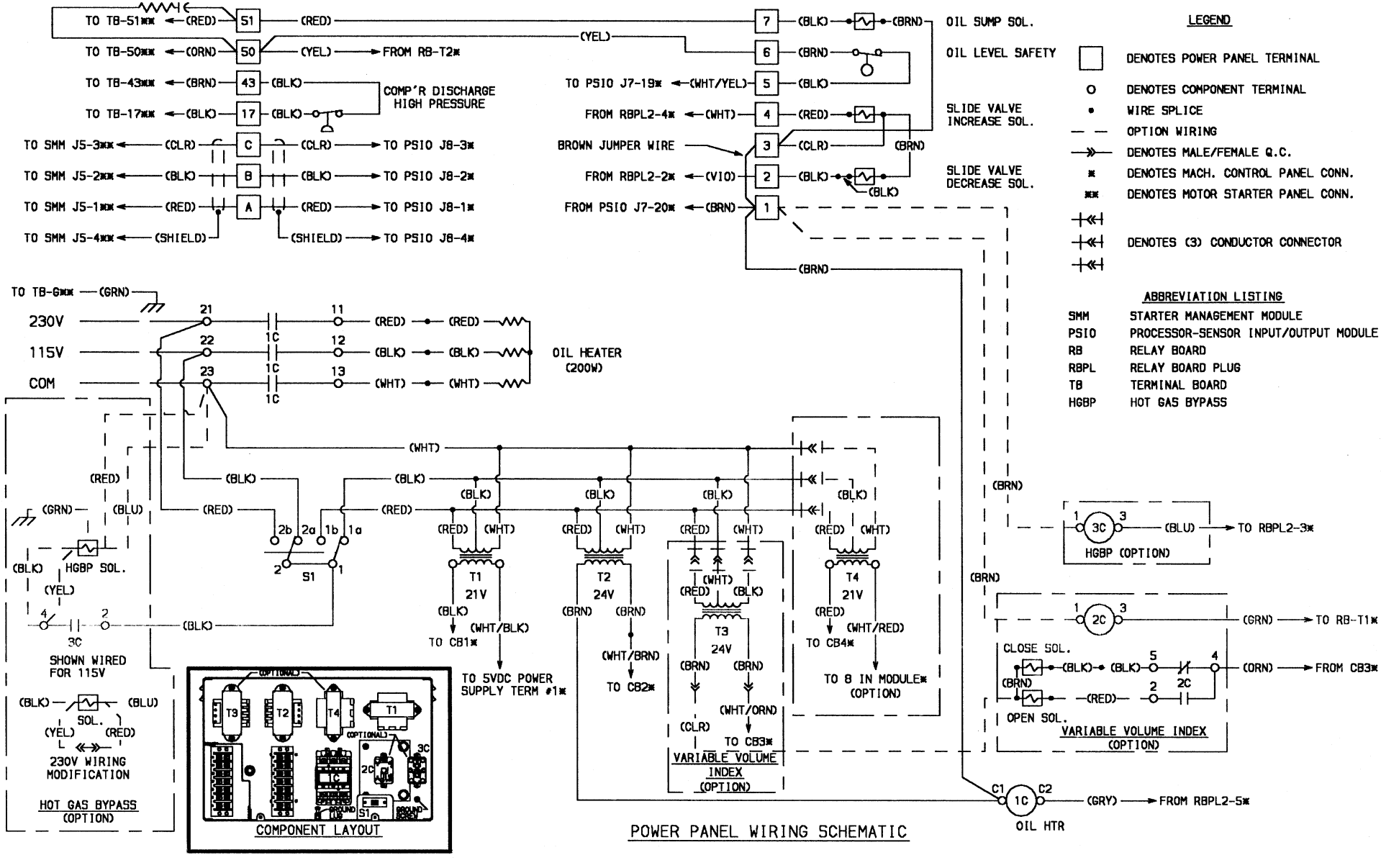


Fig. 60 — Typical Machine Power Panel, Starter Assembly, and Motor (Frame 1 and 2 Machines)

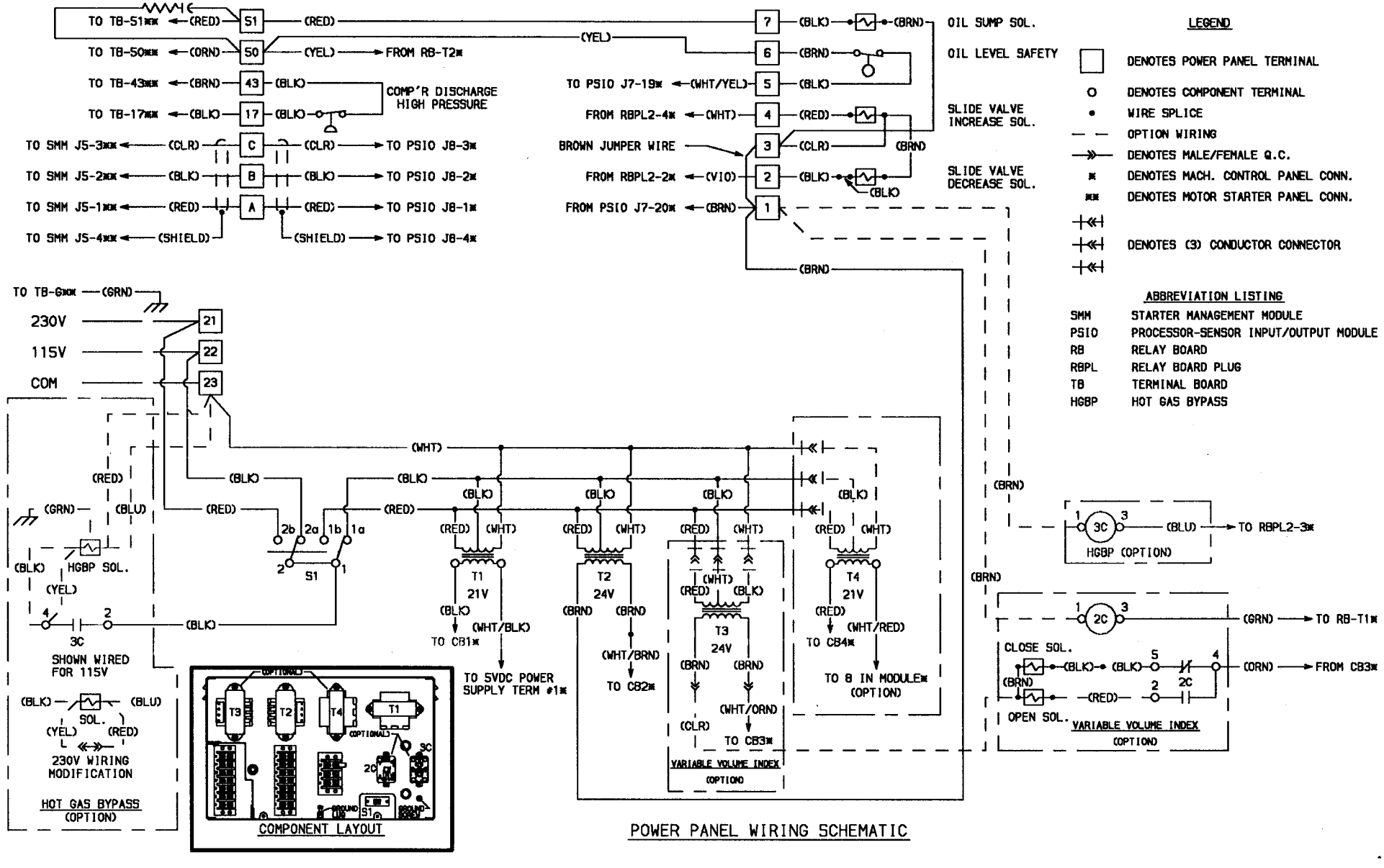


Fig. 61 — Typical Machine Power Panel, Starter Assembly, and Motor (Frame 4 Machines)

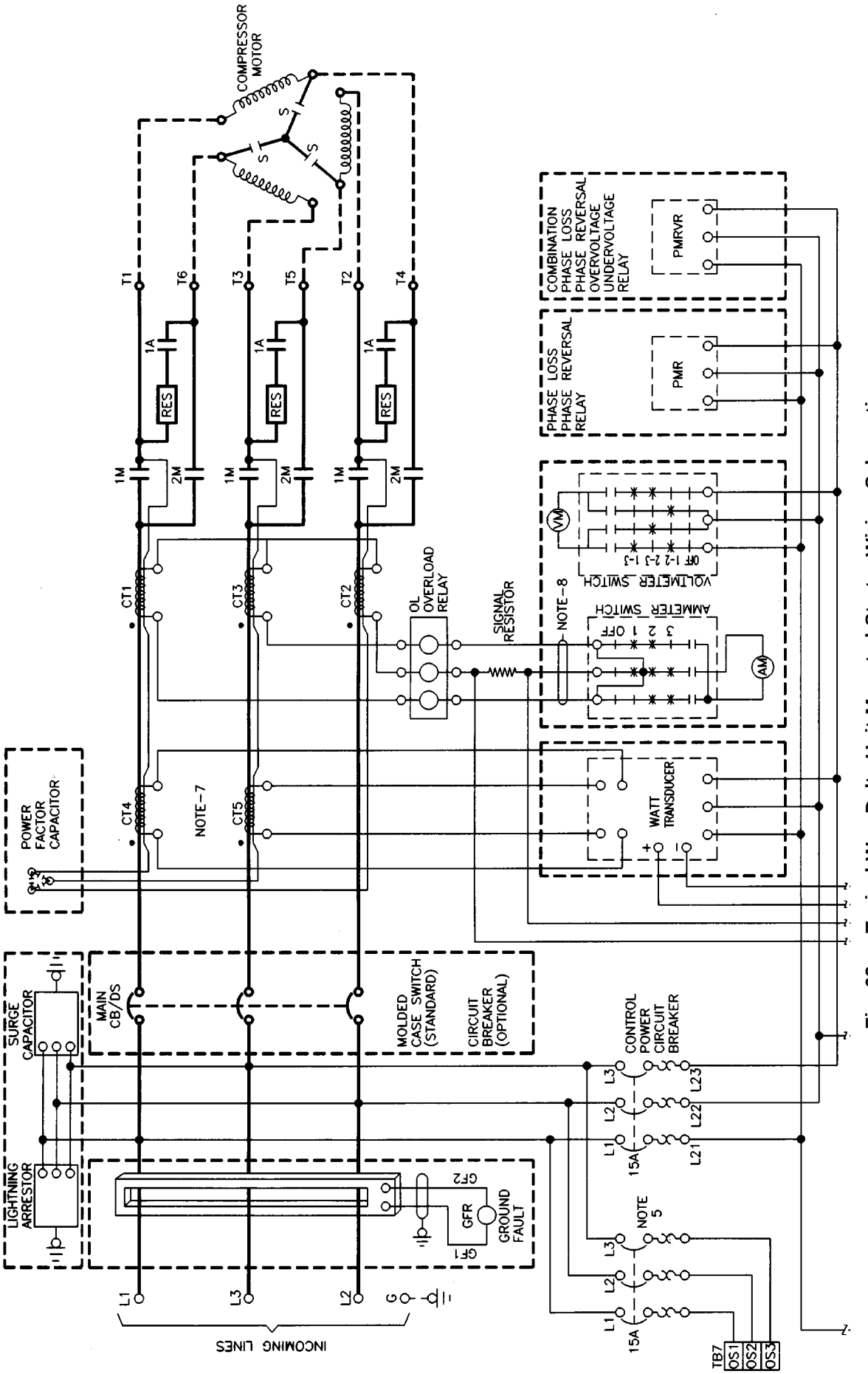


Fig. 62 — Typical Wye-Delta Unit Mounted Starter Wiring Schematic

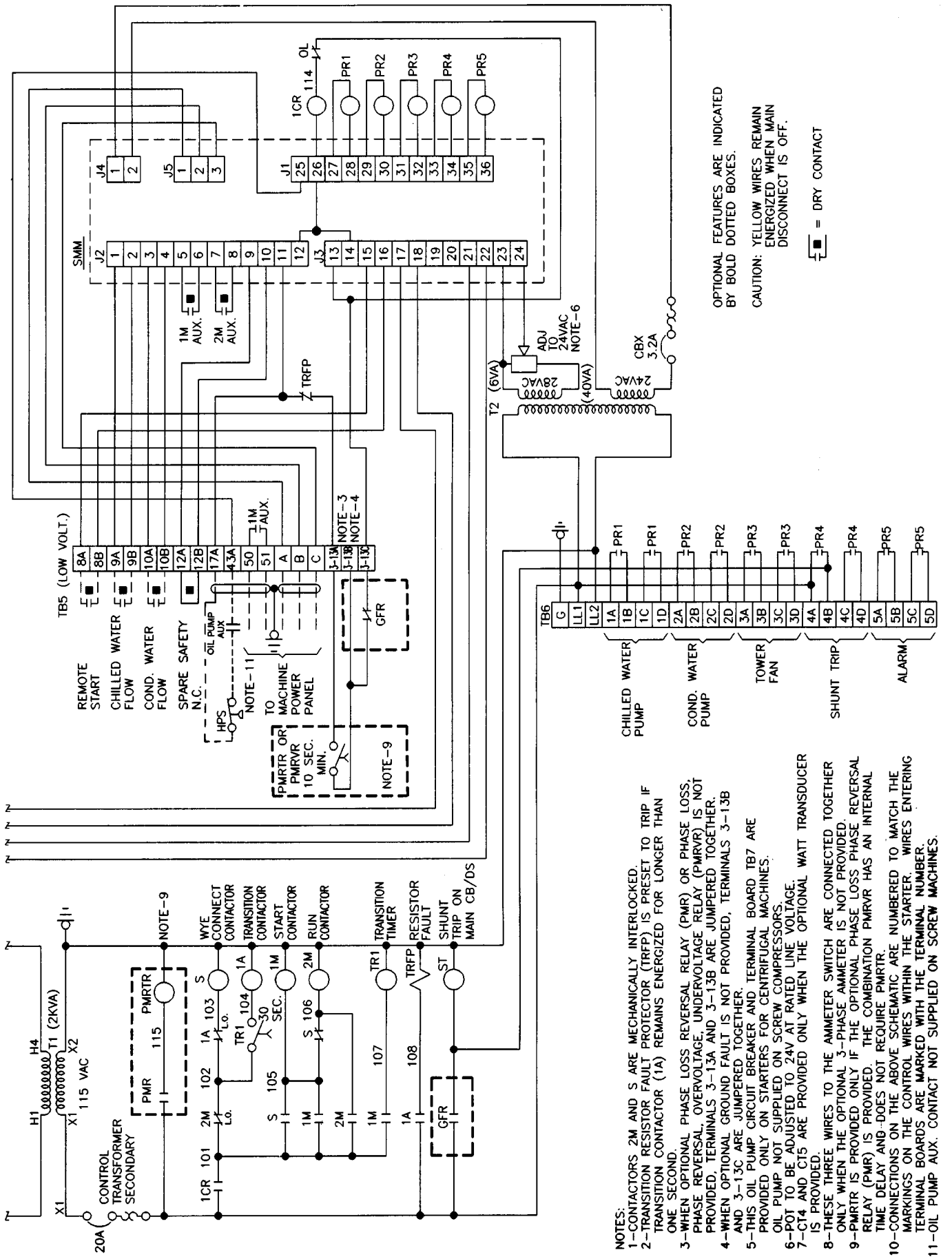

NOTES:
1-CONTACTORS 2M AND S ARE MECHANICALLY INTERLOCKED.
2-TRANSITION RESISTOR FAULT PROTECTOR (TRFP) IS PRESET TO TRIP IF TRANSITION CONTACTOR (1A) REMAINS ENERGIZED FOR LONGER THAN ONE SECOND.
3-WHEN OPTIONAL PHASE LOSS REVERSAL RELAY (PMR) OR PHASE LOSS, PHASE REVERSAL, OVERVOLTAGE, UNDERVOLTAGE RELAY (PMRVR) IS NOT PROVIDED, TERMINALS 3-13A AND 3-13B ARE JUMPERED TOGETHER.
4-WHEN OPTIONAL GROUND FAULT IS NOT PROVIDED, TERMINALS 3-13B AND 3-13C ARE JUMPERED TOGETHER.
5-THIS OIL PUMP CIRCUIT BREAKER AND TERMINAL BOARD TB7 ARE PROVIDED ONLY ON STARTERS FOR CENTRIFUGAL MACHINES. OIL PUMP NOT SUPPLIED ON SCREW COMPRESSORS.
6-POT TO BE ADJUSTED TO 24V AT RATED LINE VOLTAGE.
7-CT4 AND CT5 ARE PROVIDED ONLY WHEN THE OPTIONAL WATT TRANSDUCER IS PROVIDED.
8-THESE THREE WIRES TO THE AMMETER SWITCH ARE CONNECTED TOGETHER ONLY WHEN THE OPTIONAL 3-PHASE AMMETER IS NOT PROVIDED.
9-PMRTR IS PROVIDED ONLY IF THE OPTIONAL PHASE LOSS PHASE REVERSAL RELAY (PMR) IS PROVIDED. THE COMBINATION PMRVR HAS AN INTERNAL TIME DELAY AND DOES NOT REQUIRE PMRTR.
10-CONNECTIONS ON THE ABOVE SCHEMATIC ARE NUMBERED TO MATCH THE MARKINGS ON THE CONTROL WIRES WITHIN THE STARTER. WIRES ENTERING TERMINAL BOARDS ARE MARKED WITH THE TERMINAL NUMBER.
11-OIL PUMP AUX. CONTACT NOT SUPPLIED ON SCREW MACHINES.
OPTIONAL FEATURES ARE INDICATED BY BOLD DOTTED BOXES.
CAUTION: YELLOW WIRES REMAIN ENERGIZED WHEN MAIN DISCONNECT IS OFF.
= DRY CONTACT
CONTROL TRANSFORMER SECONDARY
20A
115 VAC
T1 (2KVA)
H1
H4
X1
X2
PMR
PMRTR
NOTE-9
WYE CONNECT CONTACTOR
TRANSITION CONTACTOR
START CONTACTOR
RUN CONTACTOR
TRANSITION TIMER
RESISTOR FAULT
SHUNT TRIP ON MAIN CB/DS
1CR
2M
1M
1A
S
TR1
TRFP
ST
GFR
SMM
J1
J2
J3
J4
J5
TB5 (LOW VOLT.)
TB6
REMOTE START
CHILLED WATER FLOW
COND. WATER FLOW
SPARE SAFETY
OIL PUMP AUX
HPS
NOTE-11
TO MACHINE POWER PANEL
PMRTR OR PMRVR 10 SEC. MIN.
NOTE-3
NOTE-4
1M AUX.
2M AUX.
TRFP
GFR
1CR
114 OL
PR1
PR2
PR3
PR4
PR5
T2 (6VA)
(40VA)
28VAC
24VAC
ADJ TO 24VAC NOTE-6
CBX 3.2A
CHILLED WATER PUMP
COND. WATER PUMP
TOWER FAN
SHUNT TRIP
ALARM

Fig. 62 — Typical Wye-Delta Unit Mounted Starter Wiring Schematic (cont)

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